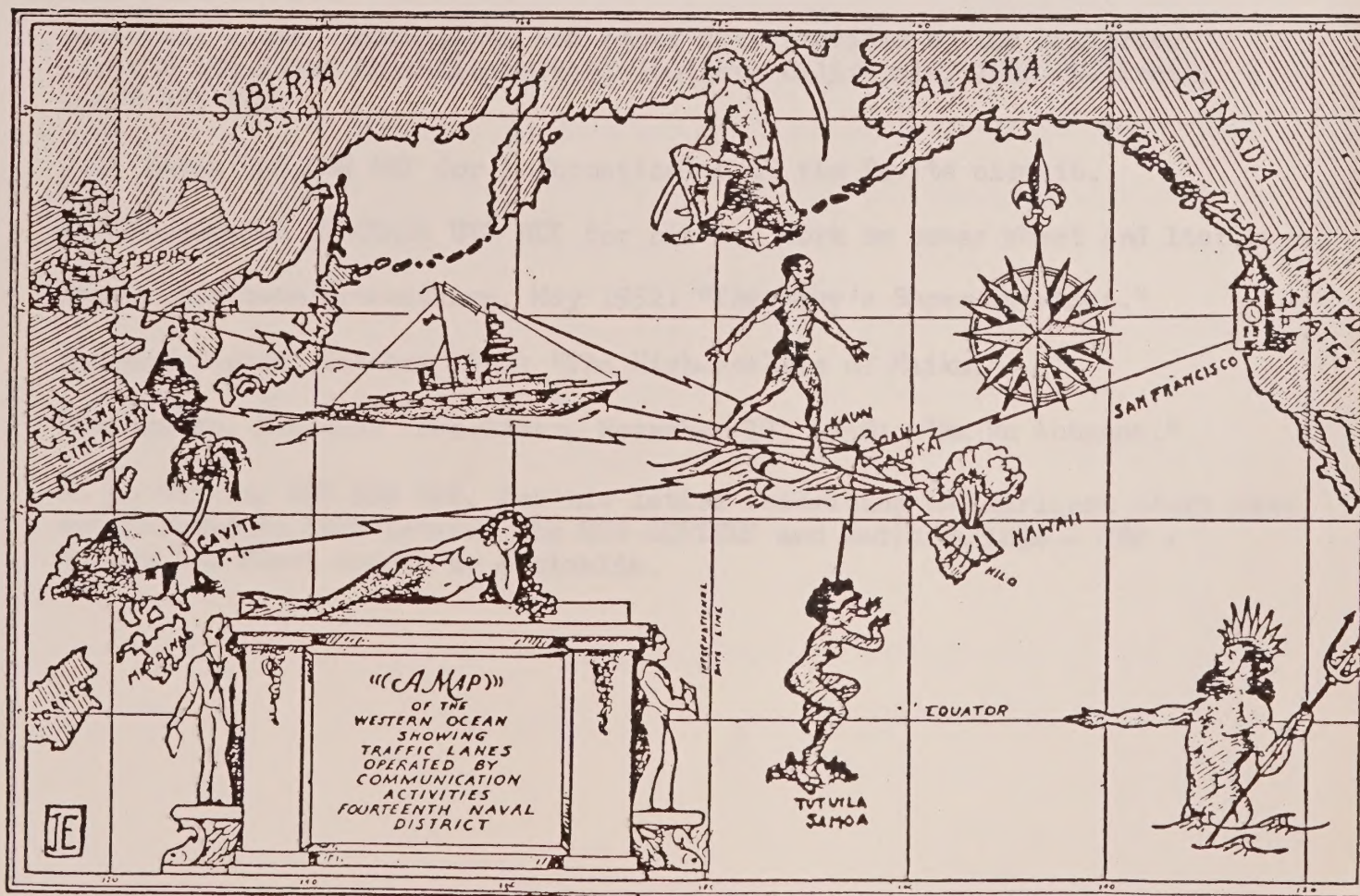






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RADIO COMMUNICATIONS IN THE FOURTEENTH NAVAL DISTRICT
TERRITORY OF HAWAII

Collected and assembled by George B. Todd, LT USN, Retired from these sources:

Dr. Dean C. Allard, Head, Operational Archives Branch of the Naval Historical Center, Washington Navy Yard, Washington, D. C., who informed me of the location of publications and documents.

Navy Department Library, Washington Navy Yard, Washington, D. C., who provided me with microfiches of administrative histories.

Administrative History of the Fourteenth Naval District and the Hawaiian Sea Frontier, 5 vols. Pearl Harbor, 1945. 803 PP. appendices.

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"NRM - 1920" by Harold B. Phelps LT USN RET, published in NAVCOMSTA "Trade Winds" June 25, 1970, Vol 5, No. 6, pp 1 & 4. Also for photographs of Wailupe 1919-1921.

"Recollections" and "Notes on NRM" by C. A. Porter LT USN, 1945.

Comments by E. A. Tucker LT USN, Communications Planning Officer, 14th Naval District, 1945.

My personal experiences at NRM during tours of duty, 1923 to 1925, and 1934 to 1937, and photographs 1923-1924.

Personnel lists, photographs and other data provided by the historian for the Old Timer Communicators of Southern California, John. W. Trott, COMDR USN RET.

John Zamba CRE USN RET for information about the Cavite circuit.

B. Groundwater LT COMDR USN RET for his art work on cover sheet and last page.

Naval Institute Proceedings, May 1952: "The Navy's Super Antennae."

Readers Digest, October 1950: "The High-Scalers of Haiku."

Bob Krauss, Honolulu Advertiser, November 17, 1958: "Haiku Antenna."

W. H. Colvin, CRE USN RET, for his letter describing the earliest short wave experiments in 1925 between the USS SEATTLE and Radio Wailupe - NRM - during the Fleet cruise to Australia.

CONTENTS

Page

2

Background history.

3-50

Radio communications.

APPENDICES

A-1 to 14

Personnel lists Communication Activities Fourteenth Naval District. (Readers are invited to submit any additional lists they might have.)

B-1 to 4

Photographs of personnel, stations & equipment 1919-1921.

B-5 to 10

Photographs of personnel, stations & equipment 1923-1924.

B-11

Photographs of demolition of 600 foot towers Highpower, Pearl Harbo

B-12 to 14

Miscellaneous photographs.

B-15

Photographs of demolition of wooden towers at Heeia.

C-1

Photographs and account of demolition of the bridge to the operatin building at Wailupe.

D-1 to 6

Descriptions of the "Super-antenna" at Haiku.

E-1 & 2

Maps of Oahu and Honolulu.

X-1 & 2

Account of the earliest short wave radio experiments, by W. H. Colvi
(Readers are invited to submit any additional data they have about communication activities in the 14th Naval District together with any photographs and documents that they want to be included in this history.)

BACKGROUND HISTORY

The first foothold on territory in the Hawaiian Islands by the United States resulted from the lease of land for a coaling station at Honolulu in 1860.

In 1866, the USS Lackawanna surveyed the islands and reefs northwest of the Hawaiian Islands toward Japan. It was as a result of these surveys that the United States established its claim to Midway.

In 1887 the U. S. Senate modified an original reciprocity treaty with Hawaii providing for an extension of the treaty, after adding an amendment providing that "His Majesty the King of the Hawaiian Islands grants to the Government of the United States the exclusive right to enter the harbor of Pearl River, in the island of Oahu, and to establish and maintain there a coaling and repair station."

Annexation of the Hawaiian Islands by the United States was approved on 6 July 1898 and on 12 August 1898 the U. S. flag was run up over the palace. The Hawaiian Islands became the Territory of Hawaii in 1899. Commander J. F. Merry, USN, became the Naval Representative in Hawaii.

From 1901 to 1908 the Navy devoted its time to improving the facilities of the 85 acres that constituted the naval reservation in Honolulu. Under the Appropriation Act of 3 March 1901 this tract of land was improved with the erection of additional sheds and housing.

Under the above Appropriation Act, Congress approved the acquisition of lands for the development of a naval station at Pearl Harbor.

Until the transfer of the Naval Station to Pearl Harbor in 1913, the naval reservation in Honolulu remained nothing more than a rather elaborate coaling station.

On 14 August 1916 the Hawaiian Islands were established as the Fourteenth Naval District, the first Commandant was Captain G. R. Clark.

RADIO COMMUNICATIONS

The Marconi Wireless Co. of America was incorporated on 22 November 1899 with sole rights to exploit Marconi patents in the United States, its possessions, and Cuba, except a newly established Hawaiian Interisland system which was retained by the British Marconi Co. Commercial wireless service was established between the main Hawaiian islands in March 1901. (This system was later acquired by the Mutual Telephone and Telegraph Co. of Hawaii).

On 22 November 1904 there were 15 U. S. Navy radio stations, fully manned and ready to receive messages at all hours, with nine more expected to be in operation within a few weeks. The latter included stations in the Canal Zone and at Cavite, in the Philippine Islands. Neither list included a station in Hawaii. The Bureau of Equipment had plans to erect stations in insular possessions at a later date.

The Navy Radio Station in Honolulu was functioning by the end of 1905 and had established a record for sending messages to a distance of 140 miles and receiving at 225 miles; by 1907 this record had been increased to 250 and 260 miles respectively.

The Navy had purchased 47 Slaby-Arco equipments from the Telefunken Co. of Germany and 10 of other manufacture. The installation at Honolulu was probably of the Slaby-Arco type. The original German equipments were very crude with little provision for changing the transmitter frequency. In most cases the emitted frequency was governed by the natural period of the antenna.

By the end of 1906, the Navy had purchased and installed equipments from many companies. About half were of German manufacture. The original transmitters had been modified to give a 500 cycle note instead of the original 50 cycle note, by increasing the number of segments in the mercury turbine interrupter. This improvement was a result of experiments conducted by a Navy operator named Woberton.

Navy installations operated in a band close to 750 kc (400 meters). There was much unintentional interference between naval, commercial and amateur stations. No attempt was made to use several different frequencies. The wide-band transmissions

of the old spark apparatus emitted at least one additional wide-band frequency almost equal in intensity to the primary and their combined emissions covered most of the spectrum in use. Control of the air was usually pre-empted by stations with high power and large antenna systems. Their transmissions carried through to their limited range by drowning out all others in the vicinity. No efforts were made to limit the power used to that required for the distance involved.

The Navy tried to exercise some discipline in radio communications by issue of a special Notice to Mariners No. 472 issued 22 November 1904. Quoting from a part of that notice: "A vessel wishing to communicate with a station and having ascertained by "listening in" that she is not interfering with messages being exchanged within her range should make the call letter of the station at a distance not greater than 75 miles from it. The call should not be continuous, but should be at intervals of about three minutes in order to give the station a chance to answer..... Then the vessel begins to send messages, stopping at the end of each 50 words and waiting until the station signals O. K. and go ahead....."

Gradual improvement in receivers was being made. Crystal detectors came into general use replacing electrolytic detectors and coherers. Pickard of Wireless Specialty Apparatus Co. developed the IP76 crystal-detector receivers. Large quantities of these receivers were purchased to replace the obsolescent original equipments. The crystal detector was improved within a few months by B. F. Weissner, a naval radio electrician's mate, by the addition of the popularly named "cat whisker," a fine metal point making contact with the crystal.

Max Wein of the Telefunken Co. developed a quenched-gap spark transmitter. The discharges from these gaps enabled the sparks to follow each other so regularly that a musical tone was emitted instead of the sharp staccato sound of the open spark. Transmission ranges were increased by a reduction in the damping effect. The transmitter tone could be adjusted so that one signal could be distinguished from another. In 1911 the Navy purchased several of these transmitters. They came into use rapidly as a modification to existing transmitters. Except for the Poulsen arc this company would have become the Navy's sole source for the procurement of transmitters following 1912.

In 1912 the U.S. Navy was directed to use the term "radio" in lieu of "wireless." Naval radio stations were opened to commercial traffic in all areas where commercial radio facilities were non-existent or inadequate.

On 13 September 1912 the Office of Superintendent, Naval Radio Service, was organized. Shore stations were divided by geographical considerations into three areas, Atlantic, Pacific and Philippines, each with a Superintendent. Initially the Pacific title was Pacific Coast Radio Superintendent, later changed to Pacific Coast Communications Superintendent, then Pacific Communications Superintendent (P.C.S.) and finally Pacific Communication Officer (P.C.O.). Captain E. H. Dodd was the first Pacific Superintendent.

In 1908 Poulsen of Denmark developed an arc transmitter. The Navy purchased two of these equipments, conducted experiments with the arc transmitter and the "tikker" receiver and recommended against their use because of the inadequacy of the receiver. This delayed the Navy's adoption of continuous wave transmissions for approximately 4 years.

Discovery of the heterodyne method of receiving continuous wave signals provided a vastly improved system for receiving the undamped arc signals. This was made possible by the development of the three element vacuum tube by De Forest.

The Washington Navy Yard designed the Navy types A, B and C receivers using the De Forest vacuum tube. These were completed in early 1915 and placed in production the same year. The Cohen method was used. This consisted of a modified type of feedback circuit to produce oscillations. To avoid use of the term "feedback," it was termed a "tickler" because it tickles the audion and "makes it quiver."

These receivers were placed in service at the shore stations and on the more important combatant ships as fast as they could be manufactured. However, economy dictated the continued use of the crystal detector, and the heterodyne feature was used only for the reception of continuous wave signals.

In July of 1911 the Federal Telegraph Co. of California was incorporated. It owned the U. S. rights to the Poulsen arc transmitter patents. In 1912 this company established a circuit between San Francisco and Honolulu using 30 kw arc transmitters and the "tikker" receivers. The circuit was satisfactory during darkness and contracts

were obtained with the Honolulu papers for the daily transmission of news. Later use of the improved heterodyne receivers provided twentyfour hour communication.

By 1914 the transmitters at all of our shore stations had been equipped with either Telefunken, Chaffee or Lowenstein quenched-gap or Fessenden rotary-gap spark transmitters. These improvements made it possible to transmit simultaneously on several frequencies in the same area provided transmitter power was kept sufficiently low. Many of the transmitters had "jury-rig" frequency changers.

The Navy had purchased a 30 kw arc transmitter that had been installed at Arlington, Virginia. Tests demonstrated effective transmissions of over 1000 miles. Plans had previously been evolved for a system of high-powered stations which would cover all necessary ocean areas and which would be inter-communicable and supported by the existent low-powered shore stations as a secondary system. The successful tests at Arlington convinced the Navy that higher powered arc transmitters should be used for the ocean chain.

An Act of Congress dated 22 August 1912 contained this provision: "Toward the purchase and preparation of necessary sites, purchase and erection of towers and buildings, and the purchase and installation of machinery and apparatus of high-power radio stations (cost not to exceed one million dollars), to be located as follows: One in the Isthmian Canal Zone, one on the California coast, one in the Hawaiian Islands, one in American Samoa, one in the island of Guam, and one in the Philippine Islands, four hundred thousand dollars to be available until expended." In later legislation and prior to completion of all high-power stations listed, the authorization of one million dollars was increased to \$1,500,000.

Construction of the station at Darien, Canal Zone, was begun in 1913 and placed in commission on 1 July 1915. The 100 kw arc immediately provided a signal easily received at Arlington. The "tikker" receivers were supplemented by Navy designed heterodyne receivers. The successful operation of the Darien transmitter with its increased range made possible a change of plans.

It was decided to equip Pearl Harbor and Cavite with 350 kw transmitters capable of communication with each other, thereby eliminating the requirement of relaying through Guam or Samoa. At those locations 30 kw equipments would be installed.

in the existent buildings and the antennae would be improved to provide sufficient radiation. The Federal Telegraph Co. had refused to guarantee the 100 kw arc for Darien. When asked to construct the 200 kw for San Diego and the two 350 kw for Pearl Harbor and Cavite, they were horrified and again the Bureau had to gamble that they would be successful. The contract for these was signed on 21 February 1916.

The San Diego station was the first to be completed. Although it did not go into commission until May 1917, the official trials commenced on 26 January when Lt. S. C. Hooper USN, sent the first message to Arlington using a silver key especial prepared for the occasion.

Meanwhile, construction of the stations at Pearl Harbor and Cavite was proceeding. The war caused delays in the fabrication of the towers and those for Cavite were further delayed by the British seizure of the ship carrying them. The towers were finally released after prolonged diplomatic negotiations. Pearl Harbor was placed in commission 1 October and Cavite on 19 December 1917.

Construction of the transpacific chain had necessitated overcoming many obstacles and the taking of numerous calculated risks. NRL radio engineers had claimed that the antenna voltages would be more than the existing insulators could withstand that the corona would prevent efficient radiation. When the Federal Telegraph Co. submitted a plan requiring chains of interlocking porcelain insulators, each approximately 15 feet long and at a total cost almost equal to that of the transmitter, Lt. Hooper asked the Locke Insulator Co. to design a practical strain insulator for the purpose. To the great credit of the company, they developed a practical insulator with metal corona shields which could be installed on the wings of the towers.

The day after the President signed the resolution declaring the existence of a state of war with Germany (7 April 1917), all amateur and commercial radio stations were either closed or taken over by the Navy.

The commercial radio facilities in Hawaii taken over by the Navy were:
Mutual Telephone and Telegraph Co.

5 stations on the main Hawaiian islands; controlling station at Wahiawa, Oa

Marconi Wireless Telegraph Co. of America:

Transmitter station at Kahuku, Oahu (100 kw rotary-gap spark transmitter)

Receiving and control station at Koko Head, Oahu.

(The California terminal of this transpacific circuit was located at Bolinas).

Federal Telegraph Co:

Transmitter station at Heeia, Oahu (30 kw Poulsen arc transmitter and
(100 kw arc transmitter)

Receiving and control station (location unknown)

(The California terminal of this transpacific circuit was located at South San Francisco).

In order to relieve congestion on the single transpacific cable, the Marconi circuit between California, Hawaii and Japan, and the Federal Telegraph Co. circuit between California and Hawaii, were operated by the Navy primarily for handling commercial traffic.

When the 350 kw arc transmitter at Pearl Harbor was commissioned on 1 Octol 1917, the Navy radio station there could no longer receive signals through the "mush" generated by the arc on all frequencies in the immediate vicinity of the transmitter. A location for a remote receiving and control station was chosen at Wailupe, Oahu, about seven miles east of Honolulu, close to the Marconi control station at Koko Head. Until that station could be constructed and equipped, the arc and other transmitters at Pearl Harbor were probably keyed from the commercial station at Koko Head or some other location.

H. B. Phelps, LT USN RET, was stationed at Wailupe from 1919 until 1921. His story of the establishment of the Wailupe station was published in the Naval Communication Station, Honolulu, "Trade Winds" issue of June 25, 1970. A portion of that story is quoted:

"When we entered WWI, the Navy simply moved a recruiting crew to the commercial stations and signed up the entire crew in various ratings in the Naval Reserve, put uniforms on them, and continued to utilize their communication skills under Navy supervision."

"The temporary station at Wailupe was probably built around the first part of 1919 and NPM moved there to allow the Kahuku and Koko Head stations to be remodeled. Almost the entire crew of operators at Koko Head were sent to Wailupe as USNR, supplemented by such regular Navy radiomen available. In those days not too many Navy operators had experience in handling commercial traffic."

"The Navy purchased a piece of land at Wailupe for the temporary station and it was very temporary as plans were in the making for a permanent station at Wailupe. There were three booths, more like chicken coops, scattered on the beach. Each booth, of crude construction, had room for two circuits. The roofs leaked and some of the operators had to sit under an umbrella suspended from the ceiling to keep water off the equipment. Or we would search around the yard for a scrap of tarpaper or boards to lead the water off the operating position. There were no signals piped in. Receiving antennas were strung between trees and poles."

"All control wires were very haywire, no soldered connections and very few even taped, which brought on intermittent wire trouble, rain or shine."

"There was an old house on the land. It was one big room, no doors, windows or screens. This housed the office, file rooms, ship to shore circuit and the landwire to the Honolulu city office (HU) and the office in Pearl Harbor (PH). Anyone working in this house after dusk had to put rubber bands around the bottom of their trousers and have several sticks of mosquito punk under their chair to be able to stay there. If they forgot to bring their punk or couldn't find someone else's cache they would stuff an old rag in a can and light it off. Anything was better than those mosquitos."

"We stood a three section watch, seven days a week, no rotation of watches, no days off. Straight 8 on and 16 off, and that's the way it was at the start of NPM as a government and commercial traffic station."

"When I went there in August of 1919, NPM had schedules with NPL (San Diego), NPU (Tutuila, Samoa), NPN (Guam), and NPO (Cavite). There was no direct daylight communication with NPO or JJC (Japan). NPO broadcast to NPM at midnight; NPU broadcast to NPM at 2 A.M. and NPM broadcast to NPU at 9 A.M. None of those circuits were reliable at all times due to static and fading periods. We just kept the traffic moving as best we could."

we could, all on low frequency transmitters by hand. Practically all traffic for Cavite and the Asiatic Fleet was relayed through NPN."

"The Navy had been searching around for a piece of land for the permanent receiving station and finally found some school land that was suitable, for which they traded the temporary site and started construction of the permanent building. The new site also gave room for expansion up the hill in back of the reservation."

"The station was completed early in 1921. It was built over the water to provide more land space for the proposed D.C.O.'s quarters, two duplex CPO quarters, and the single men's barracks. These were completed late in '21 or early in '22."

"About that time, the D.C.O., Lt. Comdr. C. N. Ingraham, and the Chief in Charge of the Wailupe station, made a tour of the outer islands to locate a suitable site for a compass station. They finally decided on Hilo, on the island of Hawaii, where NPH was built."

The U. S. Government's appropriation of the commercial shore stations at the start of WWI necessitated paying rightful compensations to their owners. Early in 1918 the U. S. Shipping Board requested the Navy to purchase all radio equipment on vessels owned or operated by them. The Marconi Co. was unwilling to sell those installations unless the coastal stations were included. The Navy purchased, on 1 November 1918, at a cost of \$798,000, the low-powered stations which had been taken over from the Marconi Co. plus the high-powered stations at Ketchikan and Juneau, Alaska, and Astoria, Washington. This did not include the high-powered stations used by Marconi on the trans-pacific and transatlantic circuits. The parent company, British Marconi, intended to resume operations as soon as possible after the war ended, and was making plans to utilize continuous-wave equipment. They had already negotiated for the exclusive use of the Alexanderson alternator, but this was held in abeyance.

It became known that they were also interested in purchase of the Federal Telegraph Co. Acquisition of Federal patents would give them control over the American rights to the Poulsen arc patents. To avoid complications and to obtain control of the Federal patents, the Navy, on 15 May 1918, acquired these together with three high-power and five coastal stations for \$1,600,000. This included the transmitter station at Heeia, Oahu.

As previously stated, the Marconi Co. was negotiating with General Electric Co. for exclusive use of Alexanderson high frequency alternators. The Navy desired to keep the alternator patents under U. S. control so they delayed the return of commercial stations to their owners until a new U. S. company could be formed to acquire those patents. (The war was not technically over until the peace treaty was signed by the President on 2 July 1921).

On 17 October 1919, the Radio Corporation of America was formed and came into possession of the American Marconi patents, high-powered stations, and other contracts and assets of the company. Soon after that RCA installed Alexanderson alternators at Bolinas, California; Kahuku, in Hawaii and at their station in Japan.

The President on 11 July 1919, approved the return of the radio stations to their owners on 1 March 1920. Since the government owned most of the coastal stations, legislation was required to permit use of those stations for commercial purposes at locations where proper facilities were not provided by private interests. Congress on 5 June 1920 authorized the use of naval radio stations for a period of 2 years for handling commercial traffic. This was extended until 30 June 1925 by another resolution approved 14 April 1922. Still further extension until 30 June 1927 was granted by Public Resolution approved 28 February 1925. Prior to the last extension, the authority was made permanent by the enactment of Public Law 632, approved 23 February 1927. In 1924 the commercial companies commenced the use of higher frequencies which allowed coverage of larger ocean areas by their coastal stations, and from that time there was a gradual diminution of the assistance needed from naval radio stations.

From the time of the armistice on 11 November 1918, until the commercial stations were returned to their owners, the Navy continued to conduct all commercial radio business of the United States in addition to providing radio service for itself and other government departments. Due to rapid demobilization, most of the shore stations were operating with about 40 percent of their complements. This condition would have been aggravated had commercial positions been available for Navy radio operators. Following the war the naval shore radio stations continued to handle radio communications for other government departments.

My first duty assignment, after graduation from the Navy Radio School, Great Lakes, Illinois, in 1923, was as an "arc engineer" at the Navy High Power Transmitter Station, Pearl Harbor, Territory of Hawaii.

That station was situated on a plot of land on the east shore of the harbor entrance channel, about half way between the Naval Hospital and the Navy Yard drydock. The transmitter building was directly under the lead-in from the massive antennae suspended from three 600 foot steel towers.

The transmitter building contained the 500 kw arc transmitter (which had been upgraded from the original 1917 350 kw installation); two huge motor-generators to supply power for the arc (one a standby); the arc helix and frequency-changer; numerous keying relays around the base of the helix; oil transformers; control panels; a water cooling tower; a 5 kw quenched-gap spark transmitter; and a Model TD vacuum tube transmitter.

The AC motor - DC generator provided 500 DC volts to the arc converter. The arc converter consisted of a water-cooled bronze chamber in which the arc burned in hydrogen gas between a carbon electrode and a water-cooled copper electrode. (We called the carbon electrode, the "cathode" and the copper electrode, the "anode"). Above and below this chamber were two series field coils surrounding and energizing the two poles of the magnetic circuit. These poles projected into the chamber, one on each side of the arc to provide a magnetic blow-out which blew the arc flame to one side. The frequency of the emitted signal was controlled by varying the antenna loading inductance by a frequency changing component.

The early high-powered arcs were crude devices compared with later standards. The means of keying them was by short circuiting some of the turns of the antenna helix or by changing the capacity of the antenna. Thus, at a time a signal was being transmitted, the antenna emitted one frequency and, at other times another frequency, called the spacing or compensating frequency.

The key first provided to operate the changes in antenna inductances or capacities was a crude device known as the "barrel key." It consisted of a wooden lever about 8 feet long pivoted to the top of a large barrel filled with water. From

the end of the lever a heavy wire led down into the barrel where it could be made to contact a heavy metal plate at the bottom. This barrel key was connected across the ground and the insulated lower half of one of the antenna support towers. Messages could be transmitted by it at the rate of about eight words a minute provided a sufficient relay of operators were available for pumping the lever. In 1916 Lt. W. A. Eaton USN, devised a multi-contact key which provided one contact for each turn of the helix. This solved the keying problem insofar as manpower and speed of transmission was concerned but did not eliminate the compensating frequency.

In addition to this compensating frequency the arc also emitted numerous harmonics of both the transmitting and compensating frequencies and, additionally, its tone was quite mushy. With the reactivation of amateur activities in 1919 and the advent of broadcasting in 1921, considerable criticism was justly leveled at the Navy because of the interference they caused.

Lt. Eaton devised a satisfactory uniwave keying system to eliminate the compensating frequency by utilizing a bank of noninductive resistance units between the transmitter and the antenna and an absorbing circuit. Radio Aid Hallborg devised a system to eliminate harmonics and reduce mush by coupling the arc to a rejector circuit in series with the antenna.

Neither the uniwave keying system nor the harmonic eliminating system had been installed in the Pearl Harbor arc transmitter while I was stationed there in 1917. There were no amateur stations in the vicinity of the Navy Yard and no broadcast stations in the islands until one of the Navy Yard Radio Aids constructed a crude transmitter about 1924 and commenced to broadcast phonograph records over the air. That transmitter was the forerunner of station KGU in Honolulu.

The arc was activated by ungrounding the antenna and connecting it to the arc chamber through the helix. The motor-generator was started and the motor brought to optimum speed. The DC generator was then connected to the arc and the arc was "struck". This was accomplished by moving the carbon cathode towards the copper anode until they touched momentarily. The carbon cathode rod was then backed away from the anode creating an electric arc between the two electrodes. Voltage was controlled by a variable resistor, similar to the control on an electric street car. Antenna current

was kept at an optimum level by controlling the width of the gap between the two electrodes. The carbon rod was in a holder connected to a worm drive gear controlled by a hand wheel. The rod could be moved toward or away from the copper anode by turning the wheel. The carbon rod was also continuously rotated by a motor so that the end of the rod would burn evenly and thus maintain the proper distance from the anode. Care had to be exercised to insure that the antenna current did not "fall off" when the rod had burned excessively and the gap separation increased. At times the arc operator was busy attending to one of the other transmitters and the arc antenna current would fall off enough to extinguish the arc. When that happened the magnetic circuit was broken and it was necessary to shut the entire equipment down and start over. Operator soon learned that they could put a metal bucket against the arc chamber while the arc was operating. The bucket would be held there by the magnetism. If the arc failed the bucket would fall to the floor creating a noise that would immediately alert the operator of the emergency so that he could take steps to get the transmitter back on the air. During normal operation the operator kept his eye on the antenna current meter so that type of interruption did not occur.

The fixed, water-cooled, copper anode was constructed from thick walled copper tubing formed into a "U" shape and bolted to other tubing connected to the other generator terminal. The external tubing was led to the outside water-tower for cooling, then returned to the anode and the chamber. The heat of the arc would eventually burn through the wall of the tubing of the anode so spare anodes were always kept on hand to replace the one in use. Normally the replacement was done on a scheduled maintenance basis but occasionally an anode would rupture during operation flood the chamber and extinguish the arc. This necessitated shutting down the entire operation until the chamber could be opened, cleaned out, and the anode replaced. At that time a new carbon rod was also inserted in the chamber.

As stated earlier, the arc keying system had been improved so that it could be keyed at high speed, by remote control from Wailupe. I was not aware of the frequency plan in effect at that time but I seem to recall that I had to change "wave lengths" one or two times each watch. The numbers 8000 meters and 12000 meters seem to ring a bell. The 1926 frequency assignment for Pearl Harbor was 26.1 kc which

is about 11475 meters so apparently I was not too far off.

The 5 kw quenched-gap spark transmitter was keyed by Wailupe on several different frequencies for communication with ships at sea - mostly commercial ships. Frequency of the transmitter was changed by rotating a wheel on the front of a helix, cutting in or out turns of the helix. Numerous spark gaps were located on the front of the helix, cooled by an air blower. Each gap consisted of two silver discs about two or three inches in diameter, mounted opposite each other at an optimum separation in a bolted assembly with 12 or 14 inch square metal cooling fins. Each gap assembly was inserted into one of a series of slots in the front of the transmitter. Continuity was maintained by contact between each assembly in the series. As long as proper gap distance was maintained in each assembly, the current could jump each gap and cause the transmitter to radiate. When the silver discs became eroded enough to create excessive widening of a gap, the transmitter became inoperative. In an emergency, a gap assembly could be shorted out by inserting a large screwdriver or other flat metal object between the cooling fins until a re-built gap assembly could be exchanged for the faulty one.

An early Navy vacuum tube transmitter, Model TD, with a frequency range of 100 to 600 kc and power output of 1500 watts, was used for communication with the Navy station at Hilo and with Navy and commercial ships equipped to receive CW signal.

Communication between the station at Pearl Harbor and Wailupe was by Morse sounder over an Army landline. Transmitters were also keyed by Wailupe over Army landlines.

The Navy followed tradition, even on shore radio stations. We were required to make daily 8 o'clock reports to the District Communication Officer, Lt. Comdr. Frank Loftin at Wailupe. At 2000 each evening the Chief Radioman in Charge, Nathan Adler, would bring to the transmitter building a message to be transmitted to Wailupe "PM de HP - POM SAT 2000." (Personnel, Operation, Material, Satisfactory).

The station had a single men's barracks and two duplex quarters for Chief Petty Officers. There was a boat dock on the harbor shore opposite Ford Island where we kept the station sail boat used for recreation trips in the harbor. That boat dock was located on what has been referred to in many publications as "Hospital Point."

There was a small building about a hundred yards from the transmitter building which contained a chronometer connected to an electric keying circuit. This was used to transmit time signals over the arc transmitter at specified times each day. That was another of the duties of the "arc engineer" during his watch. However he had to be relieved in the transmitter building while he performed this task. The chronometer was corrected each day by the Chief Radioman in Charge from time signals received from the San Diego transmitter.

In the fall of 1923 I was transferred to the Naval Radio Receiving and Control Station at Wailupe. There was a shortage of high speed operators at that time. The D.C.O. apparently decided that my services could be better utilized as an operator than as an "arc watcher" at Pearl Harbor.

The permanent buildings at Wailupe had been completed only two years earlier. As described by Mr. Phelps, the operating building was located over water on the shore of the bay. (Maunalua Bay extends from Diamond Head to Koko Head). It was a rectangular one-story building, on pilings in the water. The building was divided into compartments or booths, seven on each side separated by a hallway extending the full length of the building. The front of the building contained the wireroom and the Traffic Chief's booth on the left; the office of the District Communication Officer, Lt. Comdr. Frank Loftin, and the office of the Chief Radioman in Charge, D. A. Chauncey on the right. The wireroom had Morse sounder landline circuits to the Old Naval Station in Honolulu (HU) for transmission of commercial messages, other government department traffic and press despatches for the Honolulu newspapers; and a circuit to the Communication Office in the Pearl Harbor Navy Yard (AD). All message traffic was routed through the Traffic Chief's booth for circuit routing and filing.

There were ten operating booths toward the back of the building, five on each side. A porch extended around the perimeter of the building to provide access to the receiving antennas.

Despite improvement in equipment, reception was still difficult at times due to static, weak and fading signals. Separate booths were provided for operators on each circuit to minimize the additional distractions by outside noises.

Prior to and during the war, receiving equipment had been vastly improved. The Navy had designed the Models A, B, and C receivers and later the SE 143, SE 1420, SE 1530, SE 1899 and others, and separate units such as the acceptor-rejector and the ultraaudion. I found all of these types in use at Wailupe. The Baldwin type headphones were standard with their hard bakelite earpieces which could be adjusted to the ear by sliding the earpiece up and down metal rods attached to the canvas covered head piece.

I was first assigned to the wireroom because of my landline experience at Pearl Harbor. Later I had an opportunity to sample each of the other circuits; the ship-shore booth where we worked the Navy and commercial ships using the spark and tube transmitters at HP. I especially remember the Matson Line ships WMN, WMO, WMP.

Then I was given an opportunity to pound out the traffic to NPN (Guam). Messages for transmission were divided according to class, affixed to spring clips, and hung from hooks on the wall in front of the operator. The classes I remember were: RED (official Navy messages); GOVT (other government department messages); BLUE (commercial messages); SVC (inter-station messages straightening out goofs in other messages); PRESS (news despatches for newspapers); JAP CODE (messages for Japanese Government addressees, usually held for transmission on direct schedule between NPM and JAA, but relayed through Guam when direct communication was delayed); CHINESE CODE (ten letter CABLE CODE messages addressed the Chinese Government addressees always relayed through NPN to NPO for further relay to China); MSG (messages filed by Navy personnel for free transmission over Navy circuits to San Francisco for filing with Western Union or Postal Telegraph for further paid delivery within the United States).

I also was given a stint on the NPM-NPL intercept circuit. This transmitted messages for Navy ships at sea too distant from coastal stations for effective communication. Schedules were on every odd hour except 1900. San Diego (NPL) would transmit for the first 15 minutes, Wailupe would copy. Wailupe would "G" repeat-back the San Diego transmissions. Then Wailupe would transmit the next 15 minutes and NPL would repeat back the Wailupe transmissions. This gave ships two opportunities to copy each message. Schedules seldom consumed the full allotted hour.

Wailupe had once nightly schedules with JAA (Tokyo) for transmission of JAP CODE messages and with PEK (Java) for embassy traffic in Indonesia.

The 30 kw arc transmitter at Tutuila, Samoa (NPU) was in the same building with their receivers so they were not able to operate in duplex. Wailupe would transmit blind, on schedule, then wait for NPU to come on the air with their arc, receipt for traffic and then transmit their messages. NPU would then shut down and listen for the receipt from Wailupe.

My final circuit assignment was on the San Francisco (NPG) circuit where I remained for the balance of my tour. Traffic flowed freely on this circuit at high speed using Vibroplex speed keys or "Sidewinder" or "Cootie Keys." Speed was usually in the range of 35 to 45 WPM. One of the San Francisco operators whom I found most difficult to copy, when he used his "Cootie Key" was J. W. (Pop) Warner. (In 1927, Warner was the radio operator on the airplane "Southern Cross" which made the first flight from San Francisco to Australia with pilot, Sir Kingsford-Smith, co-pilot Ulm, and navigator, Comdr. Lyons, USN).

It was the usual practice of receiving operators to space their copy in groups of five so that they could easily keep track of and verify the group count of each message. This was not difficult except for the JAP CODE messages. Most of the words in those messages were 15 to 20 letters long so it was impossible to put ten words to the line - the "slop-over" of the five-word counts onto subsequent lines would soon throw the receiving operator completely off count and he would have to stop and count the words in the entire despatch before receipting for the message.

The Underwood typewriters provided were ALL CAP but only in the lower case. The upper case on each letter key was only a wavy line. Operators soon learned that it was advisable for them to learn the touch system so that they could keep their eyes on the message blank to insure that they didn't wind up with a lot of wavy lines.

There were only a total of five transmitters available to Wailupe: the arc, the spark and the tube transmitters at Pearl Harbor; and the two arc transmitters at the transmitter station at Heeia, Oahu, on the other side of the island.

The station at Heeia had been taken over by the Navy at the start of WWI, then purchased from the Federal Telegraph Co. in 1918. It was used by the Navy until

deactivated when arc transmitters later became obsolete and were replaced by high powered vacuum tube transmitters.

There were two transmitters at Heeia - a 30 kw and a 100 kw - both Federal Poulsen arcs. They were keyed by remote control from Wailupe. Communication between Heeia (HX) and Wailupe (PM) was by Morse sounder over Army landline.

Mr. Phelps described some of his impressions of the Heeia station:

"We used Heeia's 30 kw arc for communication with ships having an arc installation. We used the big arc for communication with NPG and once in a while we could use the 30 kw to NPG. If we could work a ship over a thousand miles on the 30 it was considered good."

"Federal had a wooden tower at Heeia which was about 400 feet high and not over 4 or 5 feet square straight up. It took a good number of insulated guy wires to hold this tower erect, and every bolt in the tower had to be thoroughly grounded. If any of the ground wires broke or became detached it would generally start a fire on the tower. This happened one night but fortunately a young Chinese fellow was on watch and spotted the fire. He called the Chief and told Wailupe to shut down for a while. He then strapped a fire extinguisher on his back and crawled almost to the top and put it out. They called him the crazy Chink."

Public Law Number 264, approved 13 August 1912, required all amateur stations to utilize frequencies higher than 1500 kc. As a result, the amateurs were the first to experiment with "short wave" equipments. In the early 1920's much success had been achieved in long distance communication using those higher frequencies. The Naval Research Laboratory was constructing experimental high frequency transmitters and receivers. Shore stations were encouraged to construct similar equipments using newly designed power vacuum tubes and using power sources from existing spark transmitters.

In 1924, Wailupe personnel constructed a "short Wave" receiver and installed it in the pump house near the D. C. O.'s quarters.

The first crystal controlled transmitter was completed by NRL in late 1924. A one way circuit was established between Washington and Balboa. Within one month, additional one-way night-time circuits were established with London, San Diego, San Francisco and Wailupe.

During this period radio amateurs already numbered in the thousands and they were increasingly interested in using the higher frequencies.

During early 1925, the Fleet was preparing for a cruise to Australia. An experimental installation was made in the Fleet flagship, the USS Seattle, consisting of a Laboratory transmitter operating on 5700 kc and one of the newly designed high-frequency receivers, the RG. Additionally, RG receivers were installed at San Francisco, Wailupe and Balboa. The American Radio Relay League (an amateur organization), made arrangements for cooperation of amateurs all over the world. Numerous tests were conducted during the cruise. During best transmission hours, 2330-0800, zone plus five time, little difficulty was experienced in handling direct communication with Washington, even during the period when the Fleet was in Melbourne, nearly 10,000 miles away. (I was privileged to have made that cruise to Australia in the USS Sloat (DD 316))

Following those tests, the Commander in Chief recommended the addition of high frequencies to the fleet frequency plan and that shore stations be equipped to transmit to the fleet on frequencies not higher than 9000 kc. The Bureau disregarded the latter and immediately made plans to equip 28 shore stations with transmitters and receivers with an upper frequency limit of 18,000 kc.

The Naval Communication Frequency Plan was approved early in 1926. Very low frequencies plus frequencies between 4000 and 4525 kc and the harmonics thereof were assigned naval shore stations. Once the decision to utilize the higher frequencies was made, there were no further major changes made in the modernization plan.

Harmonic operation of the earlier equipment was far from satisfactory and most of the transmissions were confined to the fundamental frequencies. Later, Lt. Comdr. J. B. Dow USN, designed an electron-coupled circuit that made utilization of the harmonics practicable.

Development of 20 kw low-frequency vacuum tube transmitters with a performance equal to the 100 kw arc transmitter gave indication that the latter type, in which the Navy had invested millions of dollars, would soon be obsolescent, however economy dictated their continued usage until such time as they became uneconomical in operation. In the meantime high power low frequency vacuum tube transmitters were being developed to eventually replace all of the arc transmitters.

Spark transmitters were to be eliminated from future consideration. The Bureau had to determine: Whether low-powered, high-frequency transmitters would render service ashore and afloat, equal or superior to that rendered by the high-powered, low-frequency arc transmitters then installed; whether highpowered, low-frequency vacuum tube transmitters should be used to replace the reliable, rugged arcs which were still capable of rendering service to the fleet, and whether, presuming that the vacuum tube transmitter was to become standard, the arcs be still further refined to render them capable of meeting requirements of standby transmitters.

Design and development of improved vacuum tube transmitters and receivers proceeded at an accelerated pace. A program for modernizing shore radio station transmitters was carried out. Models TAB-3, TAD-2, TAF-2, TAJ-1, TAQ, TAS and TAT were installed as required in those stations. In fiscal year 1930, 9 TAB-4, 2 TAW, 10 TAY and 13 XJ-2 were purchased specifically for shore stations.

In 1931, RCA was given a contract for 227 Model RAA (10-1000 kc) and 163 Model RAB (1-30 mc) receivers. These were the first alternating current receivers. They were installed during the fiscal year 1932. NRL had previously, in 1930, designed the Model RAC low frequency (12-80 kc) barrage receiving equipment for shore stations.

Following delivery of the Models RAA and RAB receivers and concurrent issue of Models TAU, TAZ, TBB and TBC transmitters, which had been purchased in 1931, the U. S. Navy possessed the most modern and efficient radio system of any navy.

In 1924 the design and development of high speed (100 WPM) keying and recording mechanisms was commenced. The first equipments were then manufactured and installed at shore stations.

The Kleinschmidt tape perforators and the Boehme keying heads became increasingly popular with Navy operators. The perforators were often used to pre-punch message traffic for transmission on the FOX broadcast circuits to the Fleet. They were also used to pre-punch message traffic during circuit outages on point-to-point circuits which could then be transmitted when communication was restored at high speeds as dictated by individual receiving operator abilities. The automatic recording devices were seldom used in the early days of high frequency communication due to the natural fading of those signals.

To provide a constant signal to the automatic recording devices from the fading high frequency received signals, the Navy designed a diversity receiving system utilizing three separate antennae individually spaced and oriented, each feeding into separate receivers. The output of each receiver actuated a common audio tone keyer. Received signals seldom faded in all three receivers at the same time. A constant tone output from the keyer was usually obtained unless receiving conditions were exceptionally poor due to signal skip. At those times the sending station was directed to shift to another harmonic frequency to improve the signal. The control station could monitor the audio tone signal from the diversity station for manual reception and/or feed the tone signal through a demodulator, convert it into an electric impulse to actuate the arm of an inked-pen and produce the dots and dashes on continuous-feed paper tape through the recording device.

Operators, with practice, soon became efficient in transcribing messages from the paper tape which could be fed through slots in front of the typewriter at speeds controlled by a foot pedal rheostat.

I do not know the date of installation of the 300 kw TAW low frequency transmitter at Pearl Harbor which replaced the 500 kw arc transmitter. It was probably early in 1930 as records indicate that the one at Cavite was installed there in 1932.

I reported to Wailupe for my second tour of duty in 1934 serving as one of the Traffic Chiefs until I went back to the fleet in 1937.

The general appearance of the station had not changed much since I left there in 1925. The road past the station had been paved. The control station was still in its original location, however the shore line had been filled in, a breakwater built, the bridge over the water replaced by a paved walkway up to the front steps of the building.

One additional duplex set of quarters had been built between the two original duplexes. A tennis court, swimming pool and recreation building had been constructed between the single men's barracks and the CPO quarters at the back of the station. A diversity receiving station had been built on top of the hill behind the quarters.

The inside of the control building was completely changed. All of the former operating booths had been dismantled, creating one big operating room. RAA, RAB and RAC receivers were mounted at the sides of the room on individual metal frames, bolted to the floor. Operating tables were portable, on casters, which could be moved to any receiver position. Plug in controls were built in to each table and receiver position.

The Traffic Chief and File Clerk occupied a back-to-back desk in the center of the room. A transmitter control panel was mounted on the Traffic Chief's desk.

High speed operating positions were located on a long table toward the back of the room. Typewriter wells and automatic recording devices were situated on both sides of the table. Kleinschmidt perforators and Boehme keying heads were mounted on tables on the back wall. A relay rack containing control panels and demodulators was mounted between the two sets of perforators. Signals from the diversity station were fed into the control panel. Transmitter keying lines to Pearl Harbor were connected to the control panel. Keying heads and operator positions were also connected to the control panel. Operators could connect the various equipments in any combination desired.

The main circuits were with San Francisco and Cavite. Wailupe no longer needed to relay Cavite messages through Guam since reliable communication had been established with Cavite using high frequencies. Guam traffic was routed via Cavite.

The San Francisco and Cavite circuits were usually maintained on a 24 hour high-speed basis using the automatic sending and receiving equipments. Some outages were experienced daily on the Cavite circuit. At those times messages were pre-punched for later transmission at high speeds when communication was restored.

Improved signal keyers were provided during my tour of duty at Wailupe. Those keyers enabled us to feed a signal from the diversity station into a demodulator then to a control line to the transmitter station to key a transmitter. San Francisco was able to key the Pearl Harbor transmitter for direct transmission to Cavite. Cavite was able to duplicate that procedure in the opposite direction. Until those procedures were perfected by long experience, Wailupe continued to record and transcribe all transmissions from each station to insure that the distant station did in fact receive the transmissions.

There was a high frequency circuit with Tutuila (NPU); another circuit on a scheduled basis with Hilo (NPH); and a ship-shore circuit with Navy ships on 355 kc split-foned with 500 kc, the International Distress Frequency.

A Fox method broadcast circuit for Navy ships used the TAW low frequency transmitter at Pearl Harbor on 26.1 kc.

The Heeia station had been deactivated as a transmitter station. It was still owned by the Navy.

Due to the growth of naval activities in Pearl Harbor, continued operation of the High Power transmitter station there became impractical. Therefore, in 1936, the radio transmitters at Pearl Harbor were reconditioned and transferred to Lualualei. The Lualualei tract had been obtained by the Navy under condemnation proceedings in 1931 by payment of \$227,127.00. Communication was maintained during this move by shifting the FOX fleet broadcast to San Diego and by moving only one or two tube transmitters at a time. The district needed additional personnel to dismantle and reassemble equipments during the move. The required personnel was obtained by getting Bureau of Navigation permission to utilize passenger radiomen on a passing naval transport who were returning to the States on completion of their Asiatic tours of duty. One of those radiomen was our friend, R. A. Langdon RM2c.

The front part of the control building was unchanged from its original format. The DCO still occupied the front office and the Officer in Charge the next one. The original wireroom and the Traffic Chief's booth had been converted into equipment maintenance and battery rooms.

The wireroom had been moved to a room adjoining the operating room. There communication with the Honolulu and Pearl Harbor and Fleet Air Offices was maintained by teletype - not page printers, but the old Western Union ^{type} that fed gummed-tape through the machine which had to be glued to message blanks before they were delivered to the Traffic Chief.

District Communication Officers while I was there: C. N. Ingraham, Lt. Comdr USN, 1932-1934; C. F. Holden Lt. Comdr USN, 1934-1936; G. A. Poindexter, Lt. Comdr. USN, 1936-1938. Officers in Charge: CRE R. Childs 1931-1933; CRE D. H. Bradley 1933-1935; CRE H. H. Blevins 1935-1937.

Major Fleet units of the U. S. Navy arrived in the Pacific in 1939. A program to mobilize 14th Naval District communications was necessary as the Pacific system of naval communications was inadequate to serve the large fleet. When the American armada entered the Pacific, there were nine transmitters at Lualualei. The powerful 300 kw transmitter was being converted into a 500 kw transmitter (TAW-a). By 1941 there were twelve transmitters at Lualualei which were operated via Army landlines from Wailupe.

Facilities at Wailupe in 1939 were "meager," and an entirely new receiving and control station was under construction. At Wailupe in December 1941 there were seventysix men operating twelve positions to receive and send naval despatches. High speed Boehme was employed on a continuous circuit with Cavite, and a similar circuit joined San Francisco with Wailupe. San Francisco was worked on the same circuit with Washington (NSS). Each of the two mainland stations handled traffic for alternating periods of fifteen minutes. Washington was received through San Francisco on an automatic relay basis. Wailupe worked Samoa (NPU), Wellington (ZLP), Auckland (ZLD), and Canberra (VHC) on a point-to-point manual circuit.

Dutch Harbor, Peiping and Shanghai were worked one hour daily on direct circuits. A manually operated circuit via NAS Pearl Harbor, the Line Island Net, connected Naval Radio Stations on Midway (NQM), Johnston (NIQ), Palmyra (NIX) and Wake (NCL) with Wailupe.

Units afloat sent and received on 355 kc and the 4235 series through its fourth harmonic, which were manned by Wailupe continuously. The 4235 series of four frequencies was covered by only one operator controlling only one transmitter which had to be shifted from one frequency to another in the event a ship called. A continuous watch was maintained on the International Distress Frequency, 500 kc. Joint Army and Navy, Inshore Patrol, Local Defense, and Harbor communications were coordinated by several teletypewriter and radio circuits.

The most important broadcast was the Primary Fleet (FOX) broadcast which was transmitted on the frequency of 26.1 kc over the 500 kw very low frequency transmitter at Lualualei. Navy ships at sea and a majority of naval activities ashore copied the entire Fox broadcast. The Wailupe Fox was the most rapid way to get messages to ships.

When the 14th ND history was being compiled in 1945, Lt. C. A. Porter contributed his "Recollections," and "Notes on NPM." His comments are interspersed in this narrative from time to time.

Lt. C. A. Porter: "In 1940 the Navy began the construction of a control and receiving station at Wahiawa which was scheduled for completion in the year 1942. Wahiawa Radio Station was the most important of a number of naval radio and naval air radio stations constructed as part of a general plan of expansion."

The large expansion and rapid development of naval air communication require especially close control coordination by the District Communication Officer. In January 1941 NAS Pearl Harbor was the only well-equipped naval air radio station in the district. At NAS Pearl were sixteen operating positions and this station assisted Wailupe to coordinate communications with the four line islands, with Navy patrol, combat, and transport airplanes, and with surface craft in the Hawaiian area. During 1941 radio equipment was placed in operation at Naval Air Stations Kaneohe, Johnston, Midway, Wake, Palmyra, Puunene and Ewa (U. S. Marine Corps).

All naval air stations provided air to ground communications and radio aids to navigation. The busiest circuits were for training purposes, and some of these were on radio frequencies held jointly by the Army. Interisland flights were handled by air stations involved, assisted by the Civil Aeronautical Administration and NAS Pearl Harbor. Naval Air Stations furnished a constant flow of information on airplane flights, on surface craft, and on the weather which was passed on to all Navy and Army activities concerned.

The district was poorly equipped for the dissemination of information among various naval and government activities on Oahu. Teletypewriter loops connected Wailupe, Major Navy commands, Army Headquarters, the District Communication Center, NAS Pearl Harbor, The Yard Signal Towers, and the Branch Communication Office in Honolulu. Equipment used by the Navy was "antiquated," and Army cables for the teletype circuits were unreliable. The 14th ND had no terminal equipment over which unencrypted despatches above restricted could be passed. To relay despatches, manual perforation was necessary, as there was not a single automatic reperforator in the entire district until 1944. Therefore, dissemination of information among local activities was slow, unreliable, and inadequate.

A few minutes before 0800, 7 December 1941, several squadrons of Japanese aircraft passed over the Lualualei radio station on their way to bomb Pearl Harbor and airfields of Oahu. An hour prior to the attack the very low frequency transmitter at Lualualei had been closed down for repairs, but sufficient high frequency transmitters were in service to continue essential communications. As was customary when Lualualei ceased normal operations, its auxiliary station, Naval Radio Station, San Diego (NPL), was notified to stand by in the event of an emergency. When the air raid began, Wailupe attempted rather unsuccessfully to operate the very low frequency transmitter at San Diego by radio control. At 0949, before good communications with San Diego were established, Lualualei was again in full operation. At 0800 Radio San Francisco followed instructions to "plug in the automatic relay connection to Washington with Wailupe, and under no condition to disconnect the two stations until further notice."

The Army failed to come up according to the plan on the drill circuits, but the Fort Shafter Army communications center maintained a watch on another joint Army-Navy frequency with Wailupe and "everything worked fairly smoothly." Each of the four frequencies of the 4235 kc series was manned continuously, and a watch was set up on the Force Commander's circuit. Stations in the district "manned every naval frequency they could think of."

Communication between Cavite and Guam was interrupted. It was necessary for Wailupe to maintain a continuous watch on a circuit with Guam. The busiest of all was the Line Island Net, controlled by NAS Pearl Harbor, but by nightfall, stations on this circuit were under supervised radio silence.

Each major radio station was strafed by one or two planes and the naval air stations on Oahu were bombed. Casualties among communication personnel were light. District naval communications functioned satisfactorily throughout the air raids, though several activities were compelled to rely on battery units. Later in the month, Midway and Johnston Islands suffered the loss of communications facilities, but in neither place was the damage of serious proportions. The most serious loss of personnel and facilities occurred at Wake on 22 December 1941. Wake Island "disappeared on the 9th but came back fortyeight hours later to stay until its fall."

Lt C. A. Porter: "The circuit with Guam was terminated on 13 December 1941. Navy radiomen of the Philippines, their "dots and dashes dripping with contempt for the Japanese" beamed Wahiawa, on 6 May 1942, to advise that they were "Going off the air now. CUL OM." Within a few hours the antenna of the 50 kw transmitter, used by Wahiawa on the circuit to Corregidor, was "swung south-westward to Australia for the new war phase."

Radio stations of the district were vulnerable to attacks by land, air and sea. Lualualei was only 4000 yards from the shore line, and its power was received over exposed lines from the Hawaiian Electric Company, twentytwo miles away. Steps were taken to increase auxiliary and emergency power, to develop an efficient system of passive defense, to disperse transmitters, and to construct bombproof shelters for equipment and men. Three bombproof shelters for radio stations were erected subsequent to 1941, but expansion programs after 1941 seldom provided for the construction of permanent buildings even on projects long planned on a permanent basis. There was a gradual increase of auxiliary power units procured through loans from the Army and through deliveries from Bureau of Ships.

"Wailupe, too, was located on the seacoast and had neither splinter-proof nor bombproof buildings. So, on the morning of 10 December 1941, the District Communication Officer decided to have all radio equipment at Wailupe moved to Wahiawa. The new site was an excellent receiving area and the best protected radio station of the entire district. Men worked night and day to transfer operations to Wahiawa. The move became a veritable scramble causing facilities to be installed more or less at random. Relocation was completed on 17 December without the slightest interruption of communications. Equipment for receiving purposes, for control keying, and for the coding board, was located in operations building No. 2, a 100% bombproof building. A Boehme point-to-point circuit was established with Washington immediately and, though it was one of the longest circuits of this type on record, it gave excellent service. Equipment was operated at speeds of 200 to 300 words per minute to clear traffic. According to prearranged plans, the distress frequency was assigned to the Coast Guard station at Diamond Head (NMD). Diamond Head thus became the first Coast Guard station in the Pacific to relieve a Navy station of guarding the distress frequency." (Lt. Porter)

Wahiawa ceased to assist directly with trans-oceanic flights of Navy aircraft, and this service was rendered by naval air stations.

In some areas of the Pacific, the Fleet broadcast faded, and very low frequency was difficult for ships and shore stations to receive. To correct this situation, despatches (beginning 1 February 1942) for the Primary Fleet Broadcast were transmitted simultaneously on high frequencies, as well as on very low frequency, and paralleling resulted in better coverage throughout the Pacific. The improvement was made possible by the delivery and installation of equipment ordered many months before a state of hostilities existed. Increased facilities also provided a first-class link between Wailupe and Alaska, the Canal Zone, and the Navy Department in Washington.

In 1942 the district was confronted with the problem of trying to manage combat communications for too large an area on one Fleet broadcast. As a consequence, the the San Francisco Fleet broadcast was initiated and relieved Wahiawa of the Aleutian area, and later serviced all ships between Honolulu and the mainland. A point-to-point circuit with Kodiak (NHB) was also assigned to NRS San Francisco. Wahiawa was then able to concentrate on providing efficient communications for the defense of the Southern and Central Pacific ocean areas.

One of the critical moments of Pacific communications occurred when the Japanese made an assault on the island of Midway, May-June 1942. The Line Island circuit was insufficient to accomodate all operational traffic, so "the battle was fought over the Midway cable" which permitted the passage of unencrypted operational despatches. To eliminate the possibility of passing communications to the enemy by induction, the commercial cable between Midway and Guam had been cut in April 1942. The Honolulu branch Communication Office assumed control of the Midway cable circuit and set up a local Navy teletype circuit terminating in the office of the local Cable Company. Actual transmission on the cable, however, was done by civilian operators.

When operating under normal conditions, the Branch Office received press despatches through regular Navy channels and passed them to the States via commercial lines and also released the press to the Honolulu papers. This activity also received and delivered official government communication and naval despatches that were to be

sent via commercial lines. It provided an inter-connecting link into district communications by the operation of a continuous teletype watch in the Federal Building to serve various naval activities in Honolulu.

In 1942 American forces made a counter-thrust in the South Pacific area. "A duplex manual point-to-point circuit was activated between Wahiawa and ComSoPac in the communication ship USS ARGONNE. Communications were not satisfactory but improved when ComSoPac moved ashore at Noumea in October 1942, and established a point-to-point circuit with Wahiawa, though the set-up with Noumea never attained the smooth efficiency toward which all hands worked." (Lt. Porter).

"A point-to-point simplex manual circuit was established with Melbourne (VIY) in the fall of 1942. Operation of this circuit was unique in that for several weeks Melbourne used civilian operators who knew only commercial procedure. Nevertheless, communication was successful and Melbourne rapidly became one of the heaviest circuits of the Pacific. After the expansion of communications to Melbourne, circuits at Oahu remained fairly constant for a number of months." (Lt. Porter).

On 23 September 1943 the Jump FOX broadcast was instituted. Originally it was copied only by naval radio stations at Johnston, Midway and Palmyra. Before the end of the year, approximately a score of naval units received this broadcast which was still on a trial basis. The significance of the Jump broadcast grew rapidly, but reception was short of the standards of a first class Fleet broadcast. To inaugurate it, Kaena Point transmitters had been obtained from the Army, which were turned back after several months of unsatisfactory service.

In a large scale expansion program of 1943, sufficient transmitters became available and the Navy reactivated the transmitter station at Heeia, Oahu. Transmitters installed at Heeia and Lualualei, in the latter part of 1943 and in early 1944, were suitable for an efficient Secondary Fox (Jump) broadcast. Eventually Heeia transmitters were more effectively used on circuits with the mainland and Lualualei transmitters carried the Secondary Fox.

By the end of 1942 the Navy had succeeded in obtaining and delivering to the district a sufficient number of transmitters to permit the largest expansion of 14th ND communication facilities during the war. In early 1943 six buildings were erected to

to accomodate an increase of transmitters from twentytwo to fifty which made Lualualei into "a completely new station." After the installation of a cooling system for high frequency transmitters, the officer in charge was of the opinion that Lualualei was "one of, if not the finest, radio transmitting stations in existence." A corresponding increase of radio material took place at Wahiawa, and an entirely new radio station was erected at Haiku.

The Navy was cognizant of the need for another large transmitting station on Oahu in a well-protected location as a standby for Lualualei and as part of a general program of dispersion. Early in the spring of 1942 plans were drawn to build a radio station in Haiku valley. The mountain valley afforded excellent natural protection and came within the defense line of the island. Antennas were stretched between mountain tops and the project was admittedly slow, expensive, and fraught with difficulties. The highest antenna spanned 7500 feet at a height of 2800 feet. Tests made in November showed that the performance was to be satisfactory for a good Fleet broadcast though "considerably below what was expected." The Haiku radio project was completed in December of 1943, and over the 200 kw Alexanderson alternator at Haiku, messages to merchant ships, weather reports to naval ships, and despatches to submarines were broadcast.

Property was obtained and plans drawn to construct a radio station at Waimano Gulch. Transmitters were ordered for the project in 1942, but immediate danger of an enemy attack had passed by the time requisitions for equipment were filled; and the equipment was installed at Haiku, Heeia and Lualualei.

Accompanying the growth and improvement of major radio stations was a program to expand communications for naval aircraft. In 1942 communication material was allocated to naval air stations at Barber's Point, Kahului, Hilo and French Frigate Shoals. Communications at Barber's Point was primarily for the purpose of air to ground and for naval air training. NAS Hilo was completed in 1942 and with the assistance of the Hilo Section Base provided communications for the island of Hawaii. The Naval Radio Station at Hilo was dismantled early in the year of 1942. In 1942, NAF French Frigate Shoals was rushed to completion and placed into operation. It assisted in providing communications for combat aircraft during the Midway campaign.

French Frigate Shoals also set up an intercept watch on the Line Islands circuit.

NAS Kahului on the island of Maui was activated in September of 1943, and a considerable amount of its communication was joined with NAS Puunene, Puunene providing the coding guard, point-to-point inter-island circuits, and medium power air ground training transmitters for both stations. These two stations served as a Naval Communication Center for the island of Maui.

"At Line Island Naval Air Stations, well-trained units were formed to give communication service for air to ground communications, sea rescue, and inshore patrol. Functioning alongside and jointly with naval air radio stations were naval radio stations at each of these islands. NOB Midway served the Midway naval submarine operating base. Large airfields and modern bombproof structures were built at Midway and Johnston during 1943." (Lt. E. A. Tucker).

Though the island of Canton was but a tiny link in the large district communication system, in 1943 it became the first, and further developments showed it to be the only joint communication center of the 14th Naval District. NAF Canton handled air communications for the Navy and Army planes from the time of its activation until the end of the Marshalls-Marianas campaigns. Reorganization and consolidation of communication facilities at Canton created what was to be known as a Joint Air Communication System of the Pacific (JACSPAC). Cooperating in the venture were the Army Air Communication System (AACS), Civil Aeronautical Administration (CAA), and Naval Air Transport System Command (NATS). Facilities, equipment, and personnel were pooled and JACSPAC influenced the development of later air communications between the Army and Navy air stations of the district.

NAS Pearl Harbor controlled a naval air station net using the frequency of 532 kc. Over this circuit naval air stations were joined but the navy did not have terminal equipment to pass arrival and departure despatches with the necessary speed. Throughout the duration of hostilities, naval aircraft in the district occasionally arrived ahead of operational despatches concerning the flights. Gradually, however, the Navy improved its facilities and systems for air communications. An additional inter-island air station manual circuit was established. Later both inter-island

circuits for the naval air stations of the Hawaiian Islands were supplanted by teletype circuits operated over inter-island Army very high frequency radio links; and a common air/ground point to point voice frequency for transport flights.

The DCO maintained close liaison with the District Coast Guard Officer to effect required coordination of effort and activity. Under the cognizance of the District Coast Guard Officer are navigational and air sea rescue radio direction finder stations; (several D/F stations were shifted to the Coast Guard in 1944); section bases at Nawiliwili, Hilo and Kahului to serve small craft and patrol craft of the respective areas; a number of lookout and signal towers, most important of which are, Aloha, Diamond Head, and Makapuu Point; and sixteen Loran stations to enable surface vessels and aircraft to obtain a fix without breaking radio silence. Coast Guard section bases assisted the Navy by handling many despatches for merchant, Allied and Army vessels of the Hawaiian area which called on 500 kc; received and transmitted on 425 kc. At the height of operations, there were approximately sixteen officers and two hundred enlisted men at Coast Guard communication activities. The Communication Center was at Coast Guard Headquarters, Honolulu, and coding boards were maintained at the Headquarters Office, and at the three section bases. The Coast Guard transmitting station was shifted from Diamond Head to Wailupe in 1944.

The U. S. Marine Corps depended upon the regular Navy system for its communication with distant points, but maintained separate receiving, control, and transmitting stations for local and inter-island communications. The Marine Communications Center was at FMFPAC, Pearl Harbor, and its transmitting station was at Aiea. A circuit connected Marine radio stations at Pearl Harbor with Marine radio stations at Maui, Hilo and Kauai which were staging areas for Marine divisions and battalions. FMFPAC was radio guard for the other stations, and copied the Primary and Secondary FOX broadcasts. This activity was joined with Navy and Army activities via teletype channels connecting into the NTX and TWX systems. Headquarters Communications Center handled approximately 5000 messages each month. Eight officers and fifteen radiomen were on each watch at this activity.

As a general rule, communications were passed among naval activities in the district by manual operation on teletypewriter nets which were connected by Army

landlines. In early 1942 there were sixty machines on fifteen loops. By the conclusion of the second year of the war facilities for local landline communications had more than doubled. No central station controlled communications on these landlines, but Wahiawa, the District Communication Center, Army Headquarters, and CINCPQA were connected on a majority of the nets. Indirectly or directly, all major commands of the Navy, Army, Coast Guard, and Marine Corps were connected by teletype circuits which were manned continuously and were operated exclusively by service personnel.

"Teletype equipment ordered on 12 December 1942 to bring the district activities up to an efficient operating basis was many months in arriving, and came in dribblets.....(the equipment) was dissipated in meeting demands beyond the scope of anticipation.....The dispersion of naval commands, each requiring urgent receipt of tactical information, increased the complexity of the teletype problem" (Memo by Lt. E. A. Tucker).

Teletype circuits and control lines on the island were unsatisfactory due to frequent interruptions, and the installation of radio control apparatus (CCS) was adjudged to be the solution to the problem. Plans for CCS equipment were drawn before the war in order that "the Navy would not be required to rely totally on the present extremely unsatisfactory land wire connection between the various communication centers...." Construction was begun in 1942, and in 1943 CCS was installed between Wahiawa and Lualualei, Heeia, Haiku, and CINCPQA. CCS apparatus soon proved to be reliable and satisfactory and became an important addition employed in the remote control of radio transmitters in the district.

Lack of proper equipment for intra-island and inter-island communications was a serious handicap to rapid naval communications on Oahu. By a joint communication policy, the Army was given the responsibility to provide landline facilities for intercommunication between naval establishments. The following excerpts from a letter written by Rear Admiral R. A. Theobald, USN, gives a description of conditions and a statement of needs which existed to some extent throughout the war:

"During the conduct of the subject exercise I was Commander Air Group in the White Force. Preliminary investigation made it appear that the best location from which to command the Air Group was at the Naval Air Station, Kaneohe. Accordingly, throughout Exercise No. 191 command

of the land based White Air Group was exercised from that station.....

"The telephone, and page printer communication systems connecting Kaneohe, Marine Air Field at Ewa, and NAS Pearl are extremely unreliable; in fact they are virtually nonexistent. On the first day, the page printer system which is designed to furnish direct communication between Kaneohe and Ewa, ceased operating. There were no qualified naval repairmen available nor does the navy maintain line-men for the repair of this system, as far as could be ascertained. Even if such personnel had been available they could not have attempted repairs to this system because of lack of familiarity with the Army landline network. In consequence, repairs have to be executed by the Army Signal Corps, according to statements made to members of my staff. Several requests to the Army resulted in a non-productive visit by a sergeant. Monday the 14th ND repairman was at Kaneohe but stated he could do nothing as this system was an Army network.....

"From my brief experience in Exercise No. 191 it appears to me that the tactical command of land based Naval and Marine Air Forces on Oahu will be difficult if not impossible with present communication arrangements. Coordination of the detached air forces at Kaneohe, Pearl Harbor, Ewa and Barber's Point requires Navy controlled communication arrangements between these fields by installing an adequate number of trunk telephone lines. Direct telegraph and telephone lines entirely under Navy cognizance are, in my opinion, prime requisites to the coordination of Naval and Marine land based air forces on the island of Oahu.....

"Radio communication between the detached air stations is possible, of course, but this entails the same security requirements as between detached Naval units at sea. The necessity of coding and decoding radio transmitted messages between Kaneohe and other air fields on Oahu under Naval communications emphasizes the urgent need for Navy controlled land communication system for efficient control of these units in combat."

Beginning in 1942 all radio equipment from the Bureau of Ships was assigned to a Pacific Pool, and radio material was then issued to the district if its need was considered to be urgent. Installation was made by the Radio Material Office which cooperated very closely with the District Communications Office in the installation and maintenance of equipment. (Electronics Office, beginning in 1945). Considerable radio material operating in the district was on loan from one of the elements of CINCPOA, from the Army, from commercial companies and from CAA. Diverting, shifting, and reconditioning were significant parts of a program to provide radio material. Urgently needed facilities sometimes were constructed locally. Frequently equipment was obtained from commercial communication companies especially the Mutual Telephone Company, on a rental basis. A graphic idea of the equipment problem may be obtained from the following letter, informally written to

the Radio Material Officer by a radio engineer at NAS Hilo:

"The Army authorities are a little more than somewhat put out by the TCS in the control tower. In fact one fellow swears he will throw the thing out the window if its left there. I agree with him - I would too. As you know, the TCS has motor generators for both receiver and transmitter, and to make things worse, this one has a motor generator to drive the motor generators. Anyway, when the thing is on it practically drowns out everything in the room - four or five super pros and the high frequency unit used to communicate with the planes landing and taking off. The motor gens cause a buzzing thru which it is impossible to copy anyone. Even with the receiver alone on it is pretty bad.

"That's the situation. Now what to do about it. The proper thing of course would be to replace it with a unit intended for that sort of thing - TCA for instance or even a TCS with a 110V power supply using tube rectifiers. If that is out of the question then the only thing I can suggest is that we move it down to the foot of the control room. That would not be certain either because the MG noise might feed thru the 110 volt lines.

"No one around here seems to be in a hurry, so if you can't scare up a TCA or a rectifier for the TCS send me a despatch thru the section base and I'll try moving it down out of the tower. The station has no material man yet and the portable power gas generator outfit isn't very reliable. Public works man shrugs his shoulders and looks bewildered when I ask him about city power."

In 1941 "the efficiency and usefulness of communications to the Fleet suffered due to poor delivery of essential communication apparatus," and "by 1943 the disparity between that (equipment) required and that delivered was widening." In reply to an inquiry made by CNO in 1943, it was suggested that highest priority be given the following equipment: radar, reperforators, scramblers, frequency meters, TCA transceivers, FM and AM mobile receivers and transmitters and speech amplifiers, remote controls, rhombic antennas, automatic tuning, band limiters, and channel filters.

Communication facilities operated at less than their capacity in 1941. Except for communications among activities on the island, the system was capable in 1942 of absorbing the increased flow of administrative and operational despatches. Traffic at Wahiawa in January 1942 amounted to a total of 2,208,869 words. Over the Fleet broadcast 144,235 words were transmitted. Local landlines accounted for about one third of the despatches handled. The heaviest lines of communication were with Washington, Cavite and San Francisco. Communication handled for government agencies and commercial traffic formed a larger percentage of the total in the first few

months of the war than at later dates. All district communication facilities handled 400,000 despatches and 28,000,000 words during the first year of the war. This was only a small portion of the number handled in the next twelve months when groups received and transmitted tripled and Wahiawa's total approached 11,000,000 per month by the end of 1943. Within a period of less than two years, the Primary Fox became the largest radio broadcast to ships at sea. Its daily average of 150 messages increased to above 200 as the rate of transmission was gradually increased from 18 to 25 WPM. After the first year the Fleet broadcast "was saturated" and reserved primarily for operational despatches. Boehme replaced manual operations on heavily loaded point-to-point circuits so backlogs with shore radio stations seldom accumulated.

The District Communication Officer wrote:

"The subject matter of a considerable proportion of this traffic is administrative.....(and) not urgent; much is unnecessarily verbose, and some is of doubtful importance to the war effort."

Services due to errors in encipherment and transmissions also contributed to increase traffic loads. To divert despatches from the Primary Fox and to facilitate the delivery of operational despatches on all circuits, and to prevent errors in coding and transmission, large numbers of despatches were deciphered (screened) at relay stations. Incidental to the major reasons for screening traffic, important information on naval units was gleaned for routing purposes.

There were 18 sources of routing information on units of the Fleet which were routinely sent to the relay station at Wahiawa. Several of these were daily reports but the question "How Route" was an abiding one, further complicated by the gradual growth of the British Pacific Fleet and the rapid growth of the American sea and land forces. "To say that the situation regarding Fox dope is confused is to make a great understatement," wrote the Wahiawa Communication Officer. From a single Fleet broadcast, which every naval unit copied or received from others, major Pacific channels increased to three Wahiawa Fleet broadcasts. (Later Guam instituted Fox broadcasts.) With each major expansion of the Fleet, with each major invasion, and with each step toward decentralization and specialization in Pacific communications,

the problem of routing and making deliveries to innumerable action and information addressees became more complex. The most important sources of information were guard lists submitted regularly by Fleet commands, guard lists of various radio stations of the Pacific and the mainland, and despatches deciphered for the purpose of diverting messages and improvement of communications.

To improve communications, a Communication Security Unit under the management and control of the Chief of Naval Operations was instituted at Wahiawa in April 1943. This activity eventually had a complement of approximately 25 officers and specially trained enlisted men to assist CINCPAC in a program of cryptographic security, traffic control, and traffic analysis.

There were a total of approximately 55 officers and 250 enlisted men in district communications in July 1942, as compared with 5 officers and 165 enlisted men prior to 1 December 1941. Most enlisted men were radiomen occupying positions at Wailupe, the District Communications Center and NAS Pearl Harbor; or were technicians at Lualualei and Wahiawa. A majority of officers were members of coding boards of the District Communication Center, Aliamanu Crater, and Wailupe. In July 1942 fifteen officers were on the District Communication Center's coding board, and at Wahiawa there were four. (There were eleven on the JOC coding board). After two years of war, district personnel had increased to a total of approximately 700, of whom 100 were officers. More than one third of the total number of communicators of the district were stationed at Wahiawa and served on the coding board at that station.

In September 1943 fifteen coding boards of the district deciphered a total of 100,000 words daily. Line islands naval radio stations and their associated naval air stations, eight naval air stations, Navy Yard Communication Center, District Communication Center, and Wahiawa were served by coding boards most of which passed plain language messages by messenger service or teletypes to various activities for which they maintained a coding watch. (Plain language was often relayed via teletype if landlines used were on Navy property exclusively). The District Communication Center maintained a continuous coding watch of five or six officers, and Wahiawa approximately ten on each watch. There were one or two officers on each coding watch at each of the other district activities. A small number of enlisted men assisted in

Navy coding work, but these were employed in joint or liaison communications.

One major item of unfinished business in 1941 was the procurement of trained personnel. Several naval schools in the U. S. trained radiomen, technicians, or communicators prior to being assigned to the district, many enlisted men and officers received valuable experience by having a tour of duty at some naval communication activity in the States. Only a minority of men, however, assigned to the 14th ND communications during the first two years of the war were experienced or trained. Each communication activity was confronted with the problem of converting inexperienced men into efficient operators or communicators. Larger units instituted formal training and a regular course of study, and each activity trained its personnel informally. A short course of study preceded each new project or major change of policy. In the district there were usually two radio schools from which approximately forty radiomen were graduated each quarter. Many in attendance, however, were trained for service in other commands. Frequent demands by Fleet commands for experienced operators and communicators caused a constant drain on the limited number of men in district communications. Fortyfive officers and many enlisted men were assigned to units afloat between April and October of 1943, but a large number of men of the district were retained for many months and formed an experienced nucleus of communicators, operators and technicians.

Significant in the gradual process of decentralization and specialization which marked District Communications throughout the preparation for offensive combat communications was the formation of a separate communication unit for the Navy Yard, and the separation of Hawaiian Sea Frontier Communications from the district. Beginning in April 1942 the Commandant of the Yard was served by a separate radio station and coding board, the Yard Communication Office. This activity (June 1945) was situated in a recently constructed bombproof building near the Administration Building in the Yard. It served the Captain of the Yard and a score of other important Yard activities. The Yard Communication Office was assigned control of 2716 kc ship-shore frequency for ships in the Hawaiian area and monitored 355 kc harbor frequency. It also copied major Fleet broadcasts which were passed to all ships in the harbor.

requesting the service, and provided training and service for ships present.

All Navy ships in the harbor were directed to maintain an efficient radio and signal watch, and despatches for ships present were normally sent by way of Yard Signal Towers. Arrangements were made by each ship whereby it would receive any messages passed to it via the Fleet broadcasts, any messages for the ship passed by visual methods from the yard towers, and any communication for them on the 355 kc or 2716 kc harbor frequencies. DCC supplied these vessels with clear copies of all general messages and basegrams. The DCC, the Navy Yard Communication Center and communication centers of Type Commanders rendered various communication services to Navy ships present in the harbor.

Merchant, Army and Allied vessels in the harbor were permitted to cease all communication watches and receive messages "over the counter" from the Communication Office or the Port Director. Upon leaving Pearl Harbor all ships manned harbor frequencies and resumed their normal radio guards when twentyfour hours at sea. Merchant, Army and Allied ships in the Honolulu Harbor were served by an Assistant Port Director at the Aloha Signal Tower.

In February 1942 the Hawaiian Sea Frontier, an organization to perform all operation functions of the 14th ND under the administrative and technical control of CINCPAC was established and the Commandant of the 14th ND was placed in command. Commander Hawaiian Sea Frontier was a higher military title than Coml4 and the responsibilities of the DCO officially became "additional duties" of his new position. The Communication Officer of the Hawaiian Sea Frontier supervised personnel and operation of facilities to provide communications for inshore patrol, air sea rescue, defense air and naval forces, liaison with Fleet commands, and liaison with the Army. He had cognizance of communication facilities which enabled him to plot the movement of all aircraft, ships, and submarines in the Hawaiian area. Aliamanu Crater was selected as the Hawaiian Sea Frontier Communications Center. In December 1942, transfers of personnel and radio material by the Navy to the Crater "were completed," and the Crater soon maintained watch on more than a score of important radio frequencies. As soon as the Crater was in full operation, it had a coding board of nineteen officer. Prior to the establishment of communication centers for various type commanders, for

ComHawSeaFron and Joint Operations Command, and for the Commandant of the Navy Yard, practically all naval communications required for the Navy Yard and the District were provided by DCC, NAS Pearl and Wahiawa. "JOC (Aliamanu Crater) communications" as COM14 observed, "cannot be entirely separated without unnecessary duplication of personnel and equipment." So the District Communication Office continued to serve as a District Communication Center, and Aliamanu Crater operated "to coordinate communications of the Frontier and CINCPAC, the Army and the outside world." The nature of the relation between ComHawSeaFron Communications and District Communications is illustrated by the fact that the two centers oftentimes divided operational despatches to be handled on a fifty-fifty basis. The largest of the Section Bases was Bishop's Point, a ComHawSeaFron activity, which maintained a communication center to provide basic communications with small craft and patrol craft in the Hawaiian area.

After an investigation early in 1942, the District Communication Officer found that communications with the Army had failed, as vital information needed by the Navy was "incomplete, misleading, erroneous, unfamiliar....and its delivery marked by long delays." Communication facilities for the Hawaiian Sea Frontier and Joint Operations Command were installed by the Navy at Aliamanu Crater, which was Army property. The Army and the Navy had communication personnel in separate rooms at the Crater early in 1942, but communications long remained inadequate and inefficient, and efforts to convert it into a joint communications center were "haphazard." Cooperation achieved at the Crater proved to be of definite value to Pacific communications, but it was late in 1944 before the Crater functioned effectively. Eventually communications between the Army and the Navy became closely allied but remained separate.

In peace times, communications for merchant ships were provided by commercial companies. After the beginning of the Pacific war this job was taken over by the Navy. The Port Director at Pearl Harbor and an Assistant Port Director at Honolulu (Convoy and Routing Officer of Honolulu) directed this phase of naval communications for 14N. Wahiawa, signal towers, and Coast Guard stations supplied means of communications, and the District Communication Center handled coding work, much of which was eventually done at the Crater. For normal communications merchant ships called up Wahiawa or a

Coast Guard station on the distress frequency then transmitted on 468 or 425 kc while at sea. At scheduled hours these vessels copied the International BAMS broadcast, transmitted from Wahiawa. BAMS messages for the area were drafted for the Port Director by the DCC or the Crater, broadcast by Wahiawa, and repeated by other BAMS stations of the district. But many merchant ships had only one operator to perform many duties, and the BAMS schedule was frequently interrupted to transmit submarine messages. Better service was rendered by the institution of the Haiku FOX broadcasts for ships copying BAMS, by the establishment of a separate submarine broadcast, and by the broadcast of BAMS schedules from each of the Line Island naval radio stations and from the Coast Guard radio station in Honolulu. BAMS stations maintained a continuous watch of the distress frequency and passed despatches and distress calls to the Crater via Radio Honolulu. Merchant, Army and Allied ships copied BAMS and held class two Navy publications.

In accordance with Communication Instructions, major considerations in the construction of the 14th Naval District system of communications were reliability, speed, accuracy and security. Apparently the principal consideration was security. Otherwise existing commercial facilities and personnel could have been utilized to a much greater extent in passing Navy despatches. In 1941 none of the commercial radio stations was incorporated into the Navy system, and none was earmarked for use other than in an emergency. Facilities of the Mutual Telephone Company were paralleled by Navy controlled landlines in order that Navy communication would be entirely separate and be operated and maintained by service personnel. ("The very nature of the Pearl Harbor attack involving espionage and treachery," threw a pall of suspicion on all civilian activities. Contributing also "to the non-usage of commercial activities" were that the Navy lacked personnel to guard scattered commercial facilities, which were accessible for sabotage; and confusion resulting from Army martial law.)

"Radio stations of the district were inextricably involved in the offensive warfare waged by American forces of the Pacific. Tarawa was the first major invasion for which Radio Wahiawa provided communication service. According to communication operation plans, radio silence was maintained by all ships until landing was in progress. From his flagship, the Senior Officer Present Afloat contacted a joint

communication center as soon as it could be set up on the island. Communications between the Tarawa shore unit and Wahiawa were then established on previously prescribed frequencies. All traffic sent to the Tarawa shore station by Wahiawa was passed to the SOPA, and Wahiawa placed the same despatches on the Primary FOX broadcast (Lt. C. A. Porter - "Recollections").

"As a result of advances made by armed forces, circuits were established with Tarawa (December 1943), Eniwetok (February 1944), Majuro (February 1944), Kwajalein (February 1944), Hockwan (June 1944), Saipan (June 1944), Guam (August 1944), Palau (September 1944), Leyte (November 1944), Ulithi (December 1944), Luzon (January 1945), Manila (February 1945), Iwo Jima (March 1945) and Okinawa (April 1945). Some of these circuits were established on a temporary basis as communication was with an AGC (communication headquarters ship) in the harbor, or with an Army shore radio station. A number of direct circuits were discontinued after a few months of operation. A manual duplex circuit was set up between Wahiawa and Manus (NTF) when the naval base was completed in July 1944. It was soon necessary to shift to another Boehme as NRS Manus became a major naval radio station. When small islands of the Pacific fell into American hands, communicators immediately set up a continuous watch on the Secondary Fleet broadcast, and large radio stations copied the Primary, the Secondary and the Haiku Basegram schedules." (Lt. Porter - "Recollections").

Sufficient high frequency transmitters were in operation by 10 October 1944 to establish the Submarine or Peter Fox. (A VLF transmitter at Haiku was paralleled by several high frequencies). This broadcast was planned and carefully directed by the Commander of Submarines in the Pacific. Despatches were broadcast to submarines at hours when reception conditions were best and all despatches were later repeated. At other hours, news items, weather reports and administrative traffic was transmitted. By close cooperation with Wahiawa, by repeating traffic, by special care in preparing messages and by requiring frequent and complete data on every unit, SubPac maintained a high standard of naval communications. (Beginning in January 1945 all Wahiawa Fox broadcasts repeated some traffic).

Beginning in November 1944 many basegrams were transmitted by a special broadcast. Naval radio stations throughout the Pacific thereafter intercepted baseg

messages from the Haiku Basegram schedule and made delivery to addressees in their respective areas. From March 1945 until July 1945 a special Haiku William Fox carried despatches for the Third Fleet.

"When CINCPAC shifted his headquarters to Guam in early 1945, a high-speed point-to-point circuit connected Wahiawa and Guam. Wahiawa Primary, Secondary and Submarine broadcasts were automatically re-broadcast by Guam. (At the end of the war, Guam was re-broadcasting only the Primary Fox). In 1945 Guam relieved Wahiawa of several point-to-point circuits, but it was not until the last few weeks of the war that many activities afloat were served exclusively by Radio Guam or in many instances by Radio Manila (NPO). Advanced Headquarters JCA Guam worked invasions, beginning with Iwo Jima, and Wahiawa established a circuit with the SOPA's communication headquarters ship immediately after invasion began in order to take over in case of any casualty to Guam." (Lt. Porter, "Recollections").

On 14 August 1945 Wahiawa operated multiplex point-to-point circuits with Washington, San Francisco and Guam; manual duplex with Manus; manual simplex with Tutuila, Canberra, the Line Islands, and ship to shore circuits; radio teletype duplex with Kwajalein; automatic keying at a rate of 18 to 27 WPM on four major Fox broadcasts; and relay circuits with Saipan, Noumea, Eniwetok, and Okinawa via Fort Shafter, the Army Communications Center. Line Island circuits were shifted to Wahiawa in June 1944, and the Tutuila circuit was re-established in July 1945. (NPM daily operating schedule, 1 August 1945).

At Wahiawa were 101 receiving positions, eight of which were operated in connection with diversity equipment. To propagate despatches there were 87 transmitters two at Haiku; ten at Heeia, and 75 at Lualualei. These transmitters covered the spectrum from the very low frequencies through the intermediate and high frequency levels, which provided good coverage of the area from Washington to the most distant points of the Pacific. By use of a wide range of frequencies, transmitted broadcasts were received despite the location of the ship or the hour of the day. (NPM, daily operating schedule, 1 September 1945).

In an effort to handle the problem of traffic, on 1 November 1944, Fox broadcasts were re-arranged. Thereafter, the Primary Fox was copied by ships of the

CVE, DD, and IE classes and later the DM class was given the privilege. Ships of the AGC, BB, OBB, CA, CL, OCL, CV, CVB, and CVL classes and all Flag Officers Afloat copied both Primary and Secondary Fox. Submarine Fox was guarded by all vessels and units under the operational control of the Commander of Submarines of the Pacific. Other units afloat intercepted the Jump Fox. Island bases from the Marianas eastward discontinued guard of the Jump and received official despatches via point-to-point circuits. New island objectives copied Jump until directed to do otherwise. Four one hour periods were scheduled on the BAMS Haiku Fox for merchant ships, allied ships, and Army ships. Basegram centers were established at Pearl Harbor, Eniwetok, Kwajalein, Majuro, Tarawa, Guam, Saipan, and Ulithi to pass basegrams to all units in their respective areas. Eight naval activities on the island of Oahu continued to copy the Primary and seven the Secondary.

Serious delays in passing and delivery of despatches to CINCPAC and other commands resulted in a thorough investigation and "drastic changes," during the final month of the war. On 1 August 1945 once more an effort was made to organize the Wahiawa Fleet broadcasts so that important operational despatches could be passed to Fleet units without delay. Despite reforms, backlogs on Fox broadcasts caused delays which were serious and admittedly high.

ALPAC 479 provided that on 1 August 1945 the Primary should be known officially as the "Task Commanders' Fox" and be guarded by Commanders of Fleets, Task Forces, Task Groups, Battleship Squadrons, Battleship Divisions, Aircraft Carrier Divisions, Cruiser Divisions, Service Squadrons, Service Divisions, Amphibious Forces, Amphibious Groups and Minecraft in the Pacific. All other surface craft in the Pacific and commanders were to copy the Secondary (Jump) Fox now to be known as the "Ship Fox". Except where definitely notified that they were receiving on the "Ship Fox" - "it was considered safe" to deliver British messages via the Task Commanders' Fox.

The traffic load of the District varied considerably over the year 1944, but the general level was much higher than in 1943. In the early part over half of it went to or from the Commanders of South and Central Pacific. The greatest amount of

operational traffic was routed via Task throughout the duration but by the end of 1944 the Ship Fox had a backlog of important despatches requiring more than twentyfour hours to transmit. As a general rule the most experienced operators of the Fleet received Task on which more than 225 operational despatches were delivered each day. In 1944 and 1945, despatches, if not operational, were removed from Fox broadcasts and sent via the basegram schedule, point to point, or mailed. Practically all messages except operational despatches and those which could go over point to point circuits were converted into mailgrams.

The British Fleet in the Pacific increased in size, and by early 1945 was a source of considerable traffic for the 14th ND and the Fox broadcasts. Most of the Fleet was serviced by point to point circuits to British stations which relayed the despatches to British ships, but many British units ashore and afloat were served by Wahiawa. During the last few months of hostilities the routing of combined communications through the regular channels of the 14th ND continued to increase.

During each month of 1945, between 15 and 20 million groups were routed via 14th ND communication activities. To cope with the increased traffic, changes were made in the type of equipment used. High speed automatic keying (Boehme) which is capable of speeds as high as 250 to 350 WPM, was gradually superseded by radio teletype at Wahiawa. Four 60 WPM teletypes could be used on a single radio channel using multiplex equipment. The added reliability of radio teletype was due largely to the development of space diversity receiving equipment. (Modern equipment under installation (SSB) will permit usage of twelve teletypes on one circuit over one transmitter to pass six messages simultaneously each direction.)

In District communications at the close of the war there were a total of 197 officers and 1132 enlisted men. These figures do not include air stations, weather central, HawSeaFron, Port Director, Marco Pearl, RPIO, Censoring, Post Office Yard Communication offices, Coast Guard or Marine activities. Due to the growth of Guam there was a slight decrease in total number of circuits maintained and in total number of operators and communicators in the district. In June 1945, DCC handled 14,760 unclassified messages, and 478,050 groups of classified traffic. From 7 December 1941 to 14 August 1945, radiomen at Wahiawa handled approximately 5,600,000 messages

and 400,000,000 words.

By the end of April 1945, many Wave operators and communicators were in 14th ND communications. In August approximately 25 percent of the entire complement was Waves, and they were assigned to activities on Oahu, Hilo and Maui. Waves were usually experienced Navy operators, communicators or yeomen, and the period of time required for them to become of material assistance was much less than required in previous groups of personnel.

In October 1944 there were 163 machines employed on sixtytwo Navy landline circuits on the island of Oahu, and the number of teletypewriters increased appreciably each month. Most of these were type 14 and 15 devices, but the type 19 displaced other types on a few local circuits. An automatic switchboard for teletypewriters was set in operation early in the war to give flexibility to the landline system, but it was too small to be of great value. In May 1945, ten BD-100 switchboards, manually operated, were installed and provided an efficient teletypewriter exchange. For reasons of security, several landline circuits were not connected to the exchange. This innovation facilitated traffic, provided greater flexibility, released a number of teletypewriters seriously needed by smaller communication centers, effected material improvement in liaison communications with the Army, and eliminated considerable duplication of effort.

Clear copies of confidential and secret despatches frequently passed between Wahiawa and CINCPQA on a CSP1515 scrambled circuit, the only one of its kind in district communications. The latter controlled lines over which messages were often sent to eight other addressees without additional handling by coding boards. Relay service was rendered by CINCPQA if that activity was addressed; otherwise many despatches were transmitted via various landline nets from Wahiawa to be deciphered by several different coding boards. Aliamamu Crater and JACSPAC radio stations were loaned scrambler equipment by the Army.

"As late as April 1945 there was a "total lack of reperforators," and only a small supply of improved types of terminal equipment. Manual handling and retyping were required to send despatches from one loop to another. All page copy from an off-island circuit was perforated by hand when sent on local loops, and page copy

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In October 1944 there were 163 machines employed on sixtytwo Navy landline circuits on the island of Oahu, and the number of teletypewriters increased appreciably each month. Most of these were type 14 and 15 devices, but the type 19 displaced other types on a few local circuits. An automatic switchboard for teletypewriters was set in operation early in the war to give flexibility to the landline system, but it was too small to be of great value. In May 1945, ten BD-100 switchboards, manually operated, were installed and provided an efficient teletypewriter exchange. For reasons of security, several landline circuits were not connected to the exchange. This innovation facilitated traffic, provided greater flexibility, released a number of teletypewriters seriously needed by smaller communication centers, effected material improvement in liaison communications with the Army, and eliminated considerable duplication of effort.

Clear copies of confidential and secret despatches frequently passed between Wahiawa and CINCPQA on a CSP1515 scrambled circuit, the only one of its kind in district communications. The latter controlled lines over which messages were often sent to eight other addressees without additional handling by coding boards. Relay service was rendered by CINCPQA if that activity was addressed; otherwise many despatches were transmitted via various landline nets from Wahiawa to be deciphered by several different coding boards. Aliamamu Crater and JACSPAC radio stations were loaned scrambler equipment by the Army.

"As late as April 1945 there was a "total lack of reperforators," and only a small supply of improved types of terminal equipment. Manual handling and retyping were required to send despatches from one loop to another. All page copy from an off-island circuit was perforated by hand when sent on local loops, and page copy

district. Plain language traffic, as a general rule, was passed by messengers unless activities were joined by Navy owned landlines on Navy property." (Lt. E. A. Tucker).

The most important development in air communications was the commissioning of NAS Honolulu (1 January 1944) at a newly constructed air field adjacent to Keesee Lagoon and Army and civilian air transport fields. By 1944 there was a large number of naval transport planes. Nas Honolulu soon passed 15,000 words per day in official despatches, 85 percent of which were operational, to become the largest communication center for naval aircraft of the district. The Naval system of air communications was joined with the Army's to establish at NAS Honolulu a Joint Air Communications System for the Pacific.

"JACSPAC (Joint Air Communications of the Pacific) was established in 1944 and 1945 at NAS Honolulu, Palmyra, Midway and Johnston. The Official Communication Bulletin states that "JACSPAC is a function of the Army Airways Communication System, but it is augmented by naval personnel and equipment so that it can operate with either service." Army Airways Communication System was developed by the Army in the European theater and transplanted to each of the Pacific islands. In developing the system, the Army made ample provision for terminal and central office equipment necessary for its operation. As a result of its experience and facilities, the Army moved operational traffic with sufficient speed to keep ahead of airplane arrivals. Naval operational despatches concerning the movement of aircraft on trans-oceanic flights were sent in a joint code, via Army equipment and channels. With the exception of Johnston, these facilities were operated primarily by Navy personnel, under the direction of the communication officer of each naval air station. Administrative traffic was propagated via the regular Navy communication system. The Navy also provided air to ground communications at the naval air stations." (Lt. Tucker).

On 1 September 1944 a MERCO office was established at Pearl Harbor, the last of major developments in the decentralization and specialization of communication in the district. This activity was responsible for receiving and retransmitting traffic associated with the control and movement of merchant vessels, landing craft, and naval auxiliaries (traveling independently or in convoy), and for making

summaries and reports of its information and operations to commands and other MERCO offices. Heretofore, the central MERCO office of the Pacific at San Francisco, served the Hawaiian area and DCC supplied the necessary communication facilities and personnel for handling MERCO messages for the district. MERCO Pearl was first located at the District Communication Office, but after operating for a few weeks in the DCC office, the new activity was relocated in a separate office in the Administration Annex. Work for MERCO Pearl increased rapidly and by the end of the war it was served by a coding board of 36 officers handling 573,570 groups and 7,600 despatches.

In April of 1945 a board of experienced naval communicators and radio engineers representing the Chief of Naval Operations arrived in Honolulu to make a survey of communication facilities of this area and to formulate plans for the consolidation of the shore, Fleet, aeronautical, intelligence, and security communication activities . . . "covering equipment, building, housing, and logistics concerning naval communications and personnel." As the committee observed, the mushroom growth, lack of proper equipment, and the need for quick operations had led to overlapping and duplication. Definite plans for consolidation of naval communications of the island of Oahu were drawn by the committee and a beginning was effected immediately. By July 1945, the teletypewriter exchange was in operation; personnel was available; better landline service was in use; and a supply of reperforators, scramblers, and commercial terminal equipment was on hand or scheduled for delivery to the district. (Single Side Band was being installed at Wahiawa but was not in operation until September 1945).

On 1 July 1945 a major change in system and procedure was initiated to accelerate the delivery of despatches among district centers and between the 14th ND and the mainland. On all messages involved in the system (NTX) a geographical or direct routing indicator was employed which expedited delivery of a message to addressees. Originator and addressee appeared in plain language. By the inauguration of the NTX system, messages were routed and passed quickly over modern and improved equipment. It was a simplified system and served to fix responsibility on the originator and addressee for all servicing. The NTX center was established first at Wahiawa

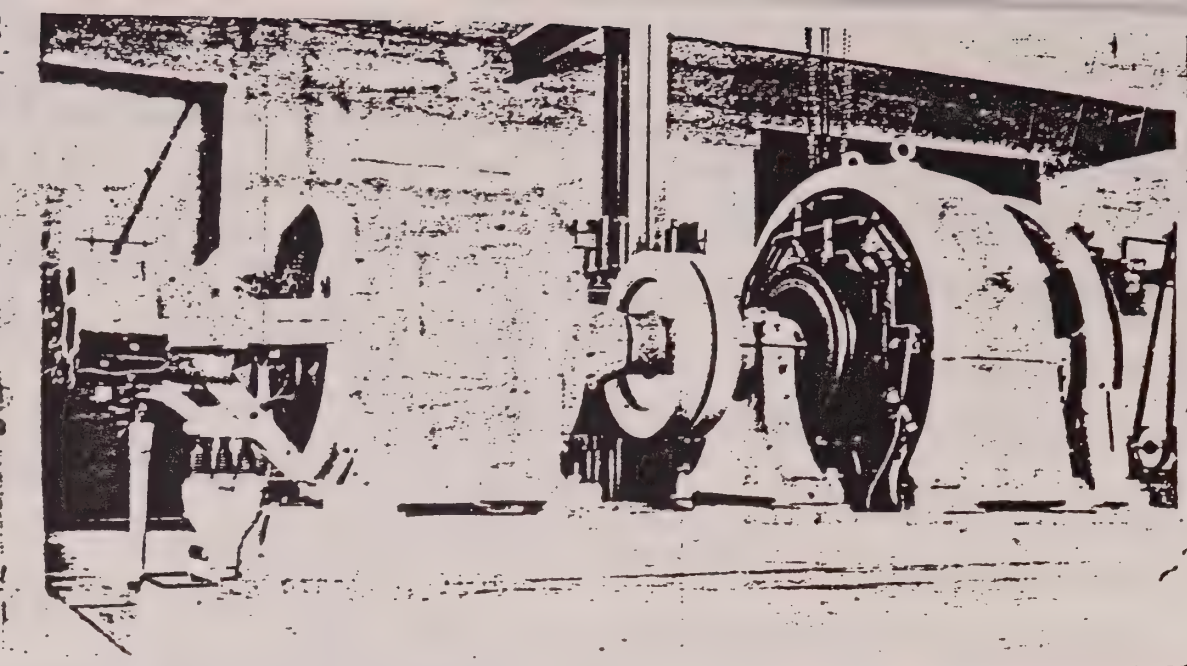
and then at Pearl Harbor, and a number of Waves experienced in the system were assigned to watches on the NTX circuits. Approximately one hundred operators and technicians were given instructions before operations commenced in July 1945.

Fourteenth Naval District Communications 7 December 1941 "had grown, to try to keep pace with expansion.....(of traffic and facilities).....without effective foresight and provision for permanency and efficiency."

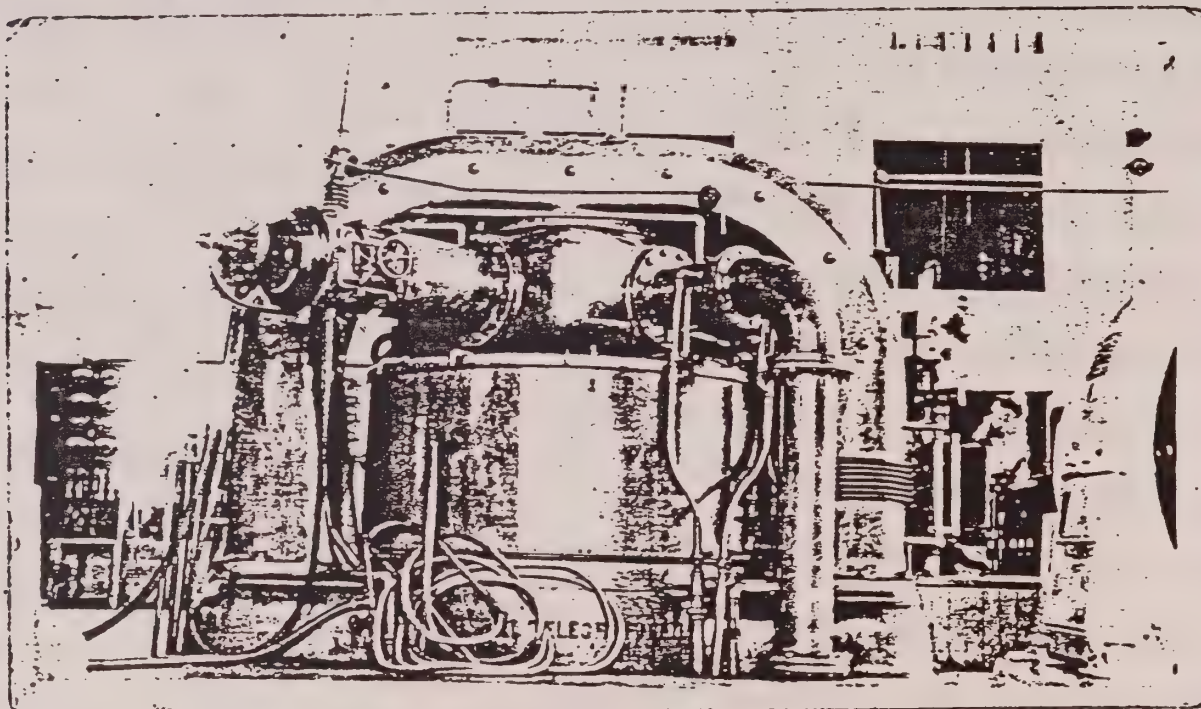
In the summer of 1945 there was a concerted effort made "to shift from urgent, quick operations to an emphasis on system and efficiency."

No history of the 14th ND District Communication Office can be complete without some mention of the unique position enjoyed by the District Communication Officer. In most Naval districts the tasks of a district staff officer were strictly of an advisory nature. In the 14th Naval District, however, this was not the case. As we have seen, the Hawaiian Islands constituted an extremely important operational center for the communications traffic all over the Pacific. As a result, the District Communication Officer had certain unusual duties not found in other Naval districts. For one thing, the DCO had certain specific operational functions. He was in direct charge of the radio stations at Wahiawa, Iualualei, Haiku and Heeia. In addition, because of the close connection with Cincpoa, it was necessary for him to handle a considerable part of this communications traffic through the stations under his command throughout the 14th Naval District.

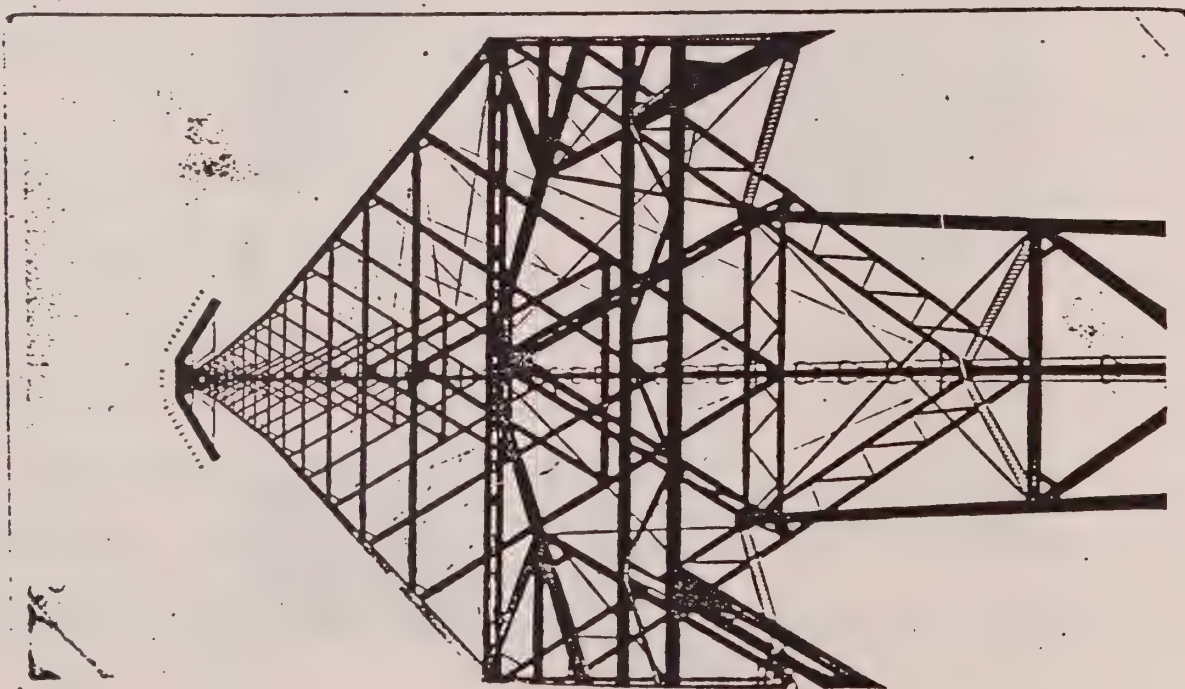




One of the two motor-generator units for the 500 kw arc transmitter, Pearl Harbor



500 kw arc chamber, Pearl Harbor, 1920, showing copper anode at left, magnetic field coils, water cooling connections. "Arc engineer" at right.



View of one of the 600 towers at Pearl Harbor, 1920.



final temporary Wailupe station, 1919



E.L.Harris, W.G.Tichenor, O.H.Scott
and H.B.Phelps all CRM, Wailupe 1919



On the boardwalk at Wailupe, 1921: N.B. "Red" Estes CRM; H.B."Skimney"
Phelps CRM,"Hook" Adams RM2c;unknown, L.R.Windser CRM & Merrill RM2c.



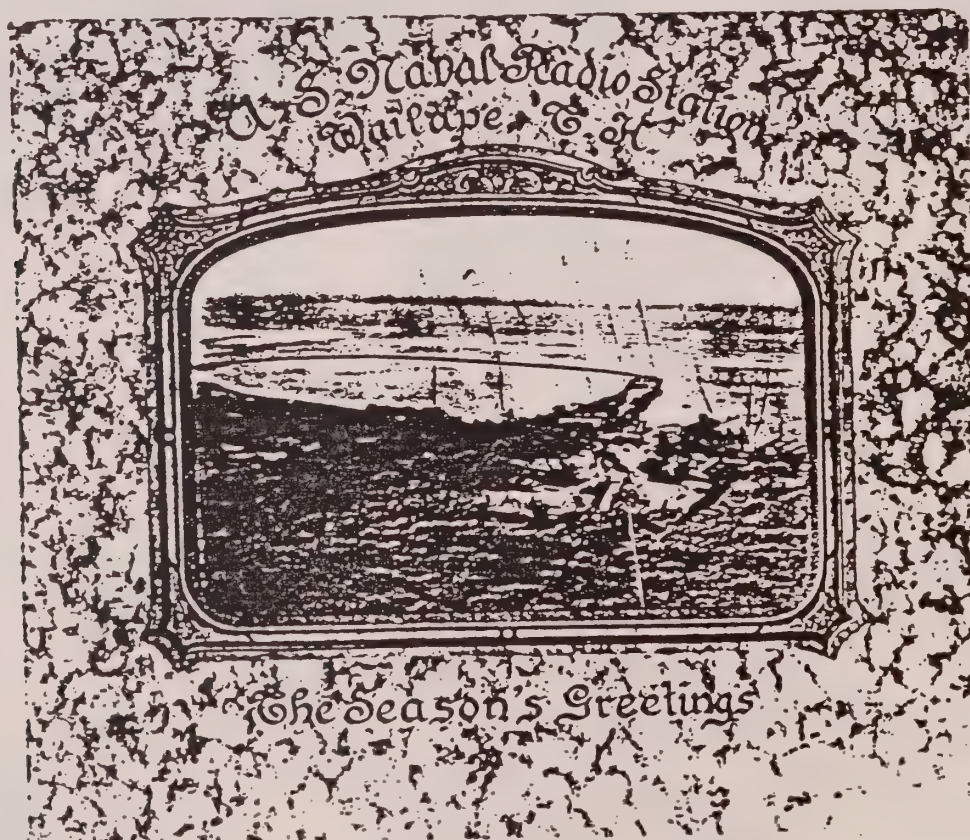
Fixed, directional loop antennas, Wailupe, 1921



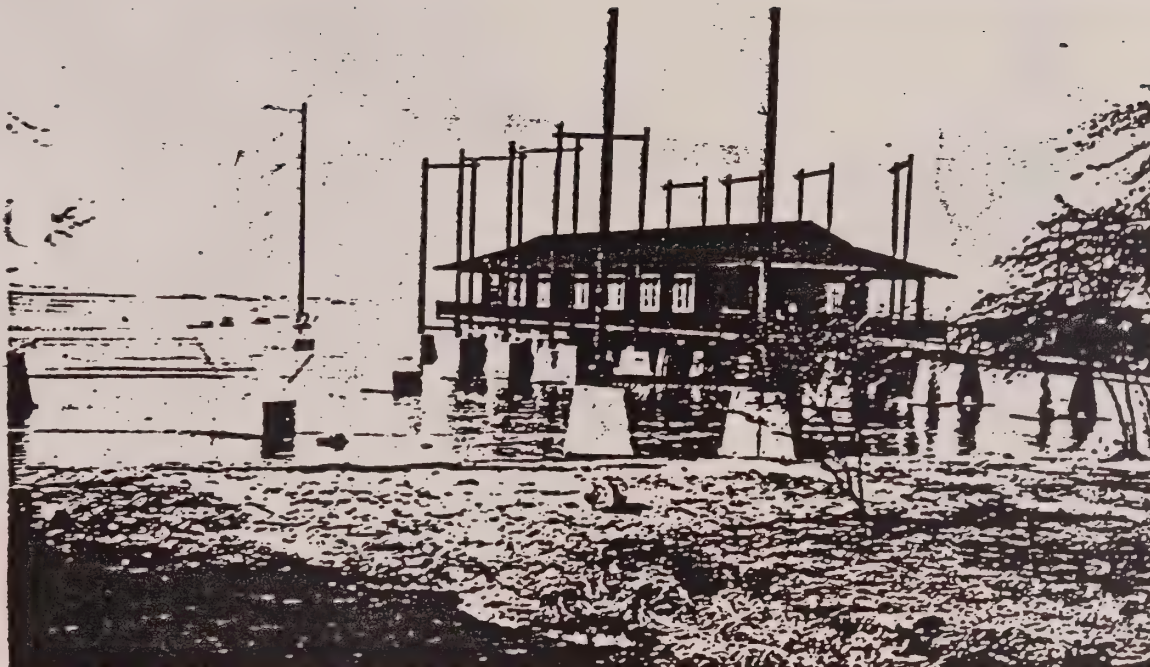
Bridge over the water, Operating building
C. R. (Shorty) Spicer, Wailupe, 1921



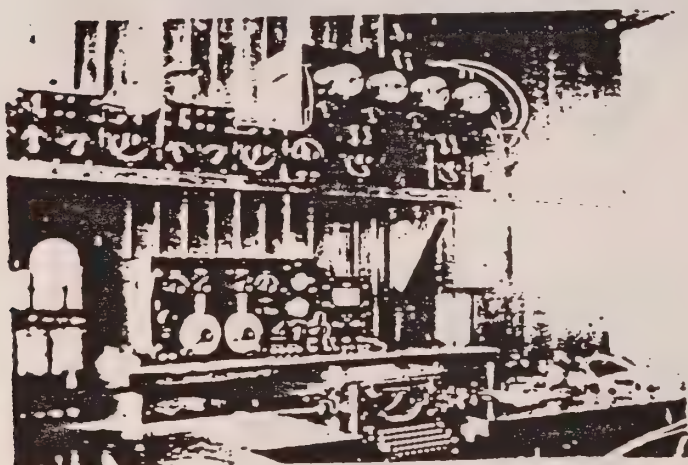
Marconi, Koko Head Control Station
Receiving antennae, 1919



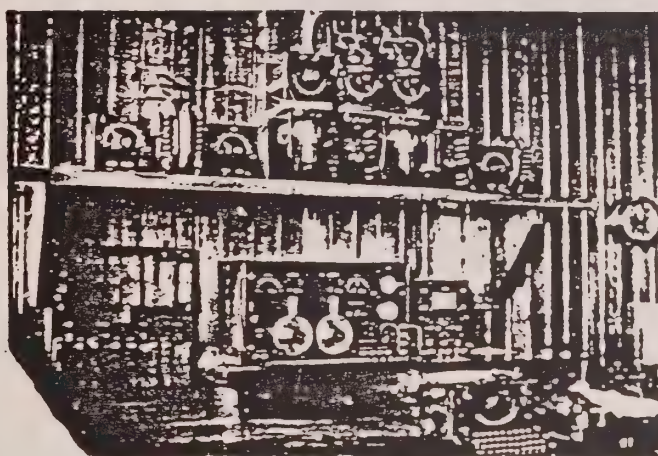
Overhead view of Wailupe Naval Radio Station 1921
(Temporary station was located to left of fish pond)



Operating building, Wailupe (NPM) taken from Koko Head side, 1921



One of the operating booths, Wailupe, 1921



Another operating booth, 1921



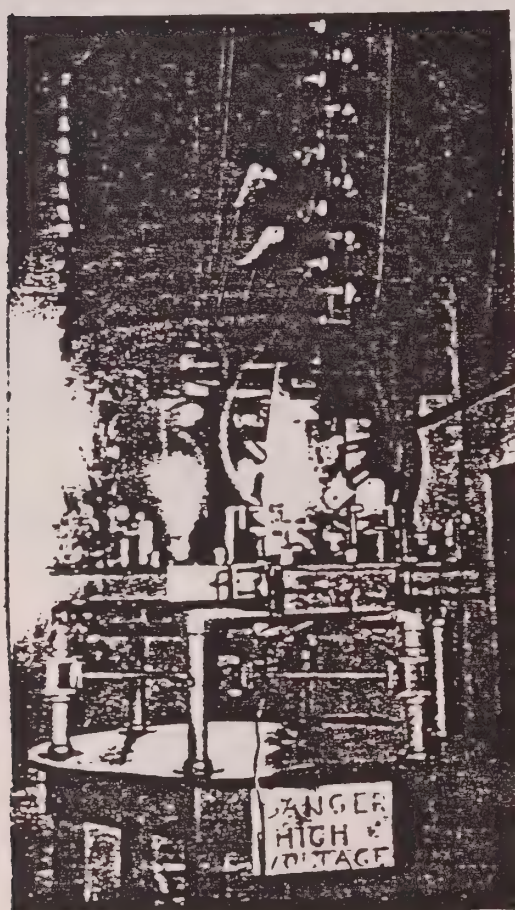
Single men's barracks, U.S. Naval Radio Station, Wailupe, Oahu, T. H. 1921



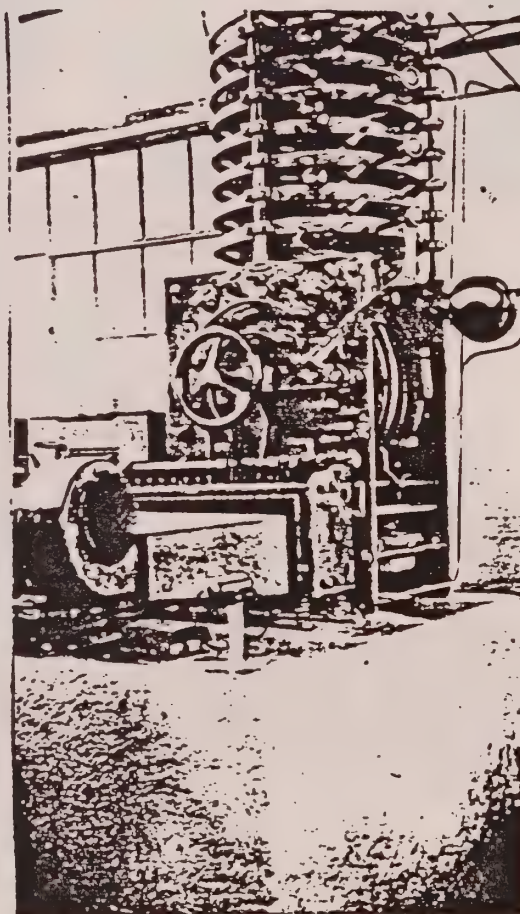
Transmitter building, High Power Radio
Station, Pearl Harbor 1923



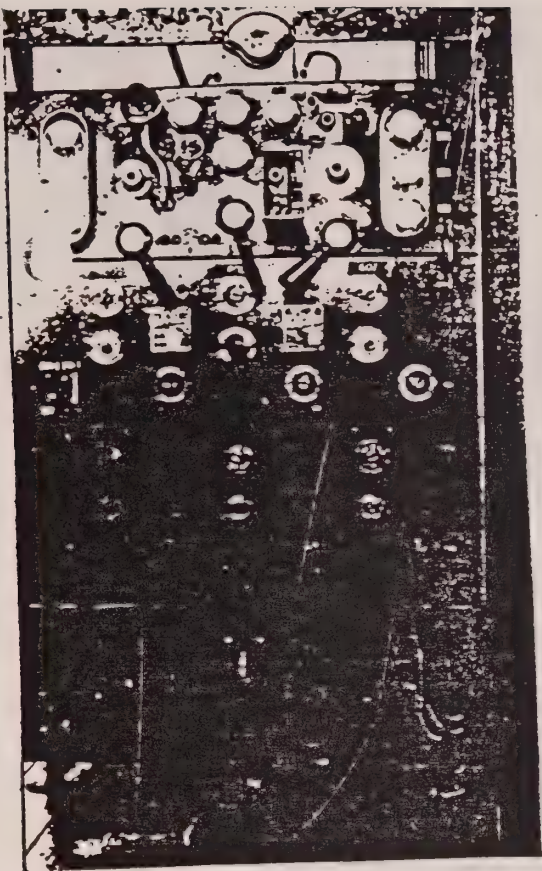
Control Panel, 500 kw arc,
Pearl Harbor 1923



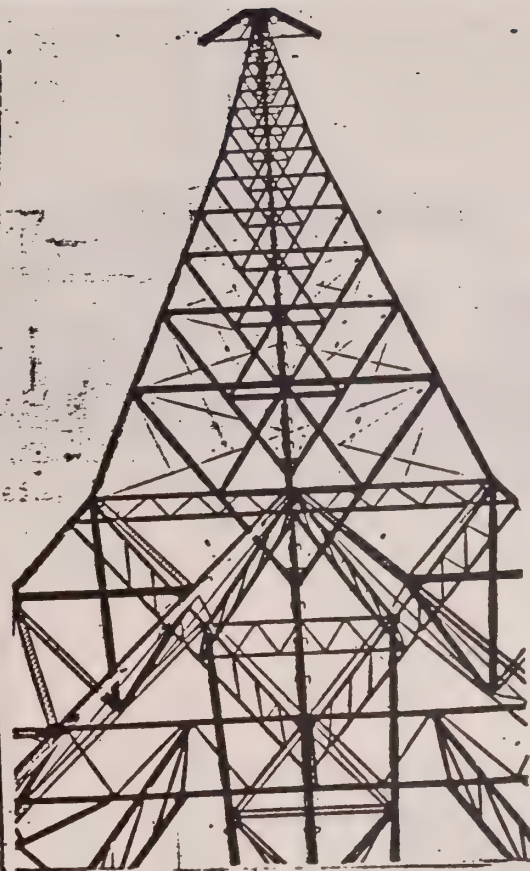
Arc helix with keying relays
Pearl Harbor 1923



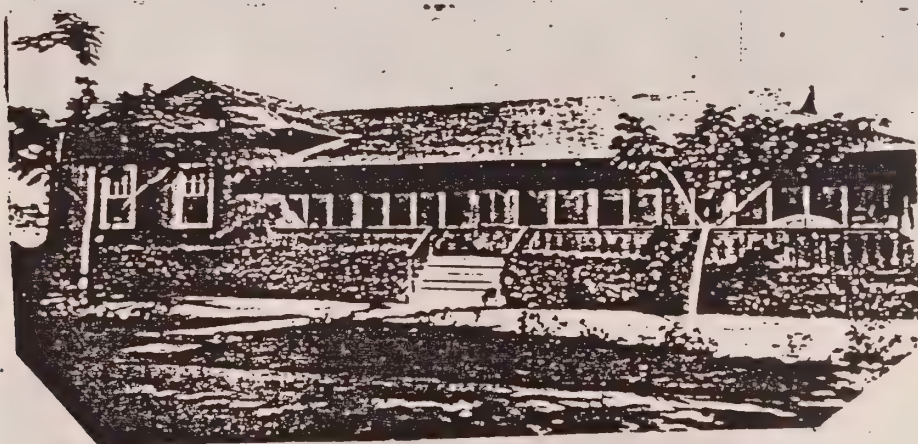
5 kw quench-gap spark
transmitter, Pearl Harbor 1923



Model TD tube transmitter
Pearl Harbor 1923



One of three 600 foot antenna
towers, Pearl Harbor 1923



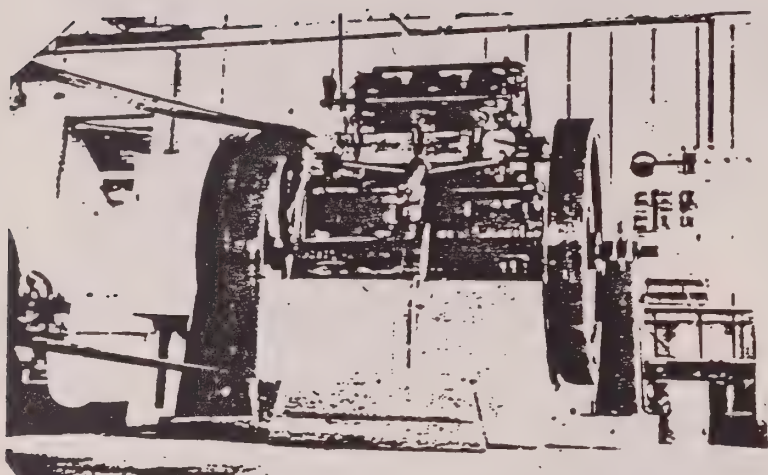
Single men's barracks, Pearl Harbor 1923



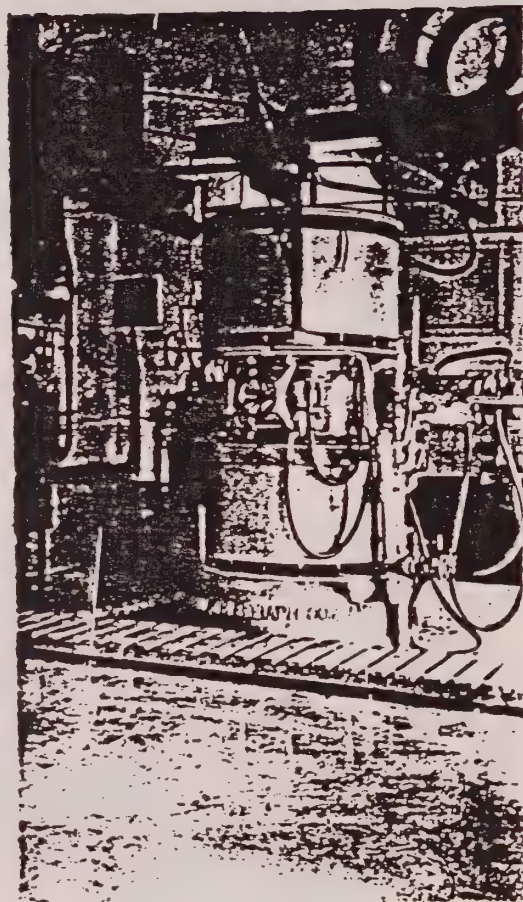
CRM in charge Nathan Adler
& station CEM, Pearl Harbor 1923



Transmitter building, Heeia, 1923.



Emergency power gas engine - motor generator, Heeia 1923



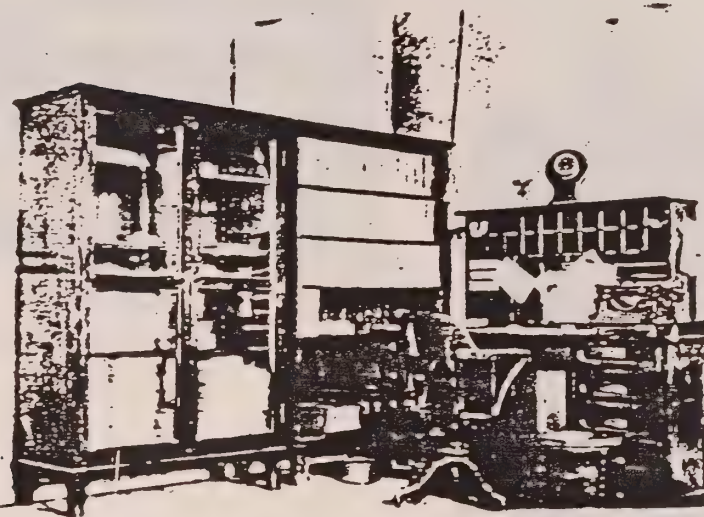
100 kw arc transmitter, Heeia 1923



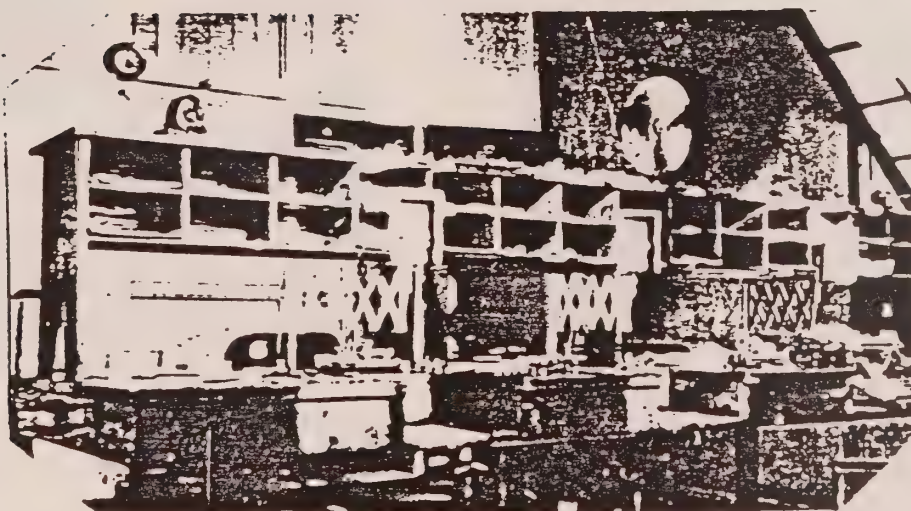
Single men's barracks, Heeia 1923.



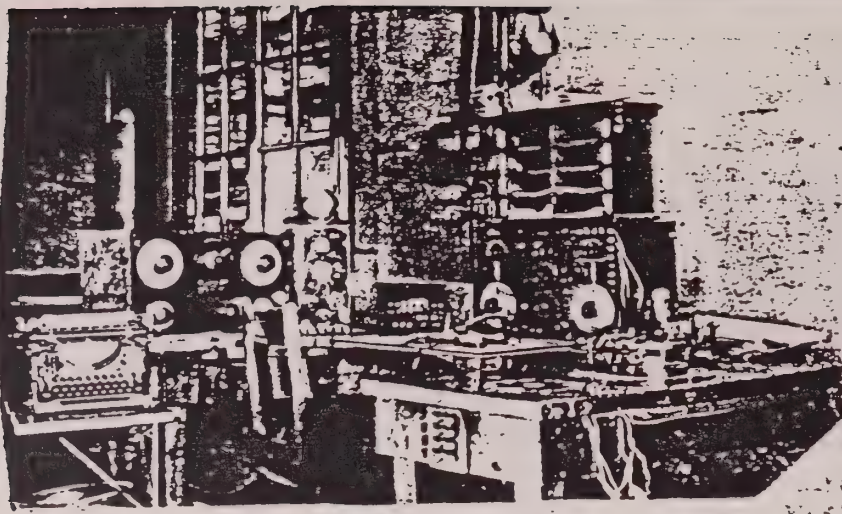
Operating building, Wailupe 1924



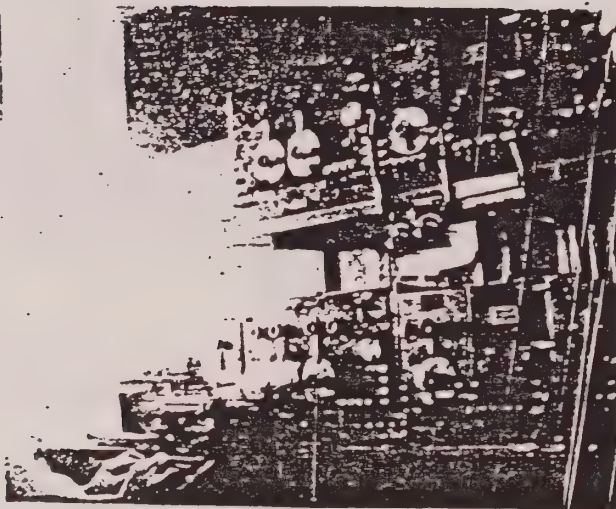
Traffic Chief's booth, Wailupe, 1924



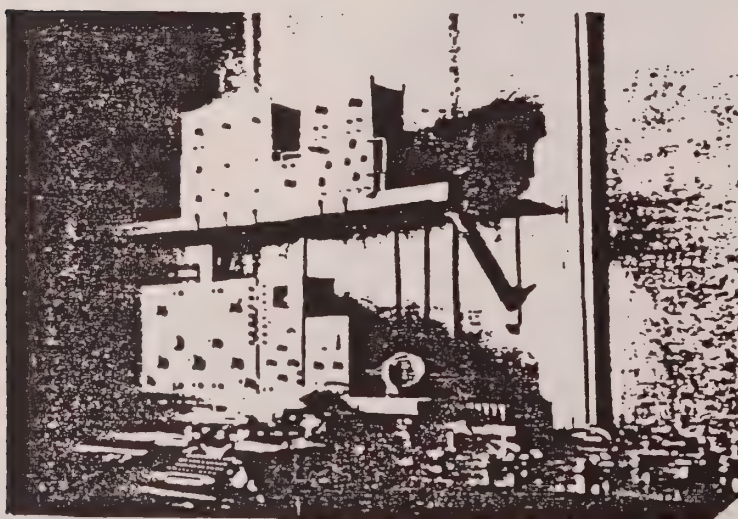
Wire room, Wailupe 1924



Ship-shore booth, Wailupe 1924



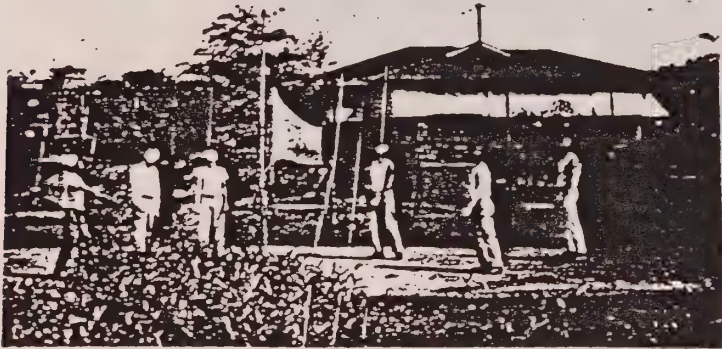
San Francisco (NPG) booth, Wailupe 1924



San Diego (NPL) Fleet intercept
booth, Wailupe 1924



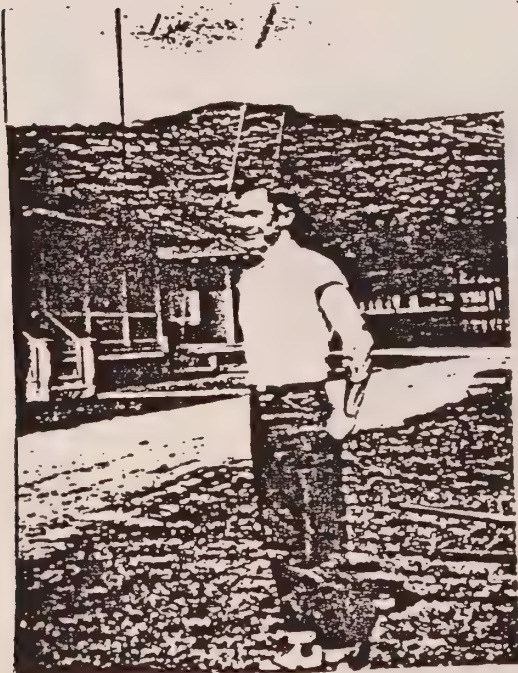
Working party, McNally, Wagner, Palmer, Richardson.
Single men's barracks & volley ball court. Wailupe 1924



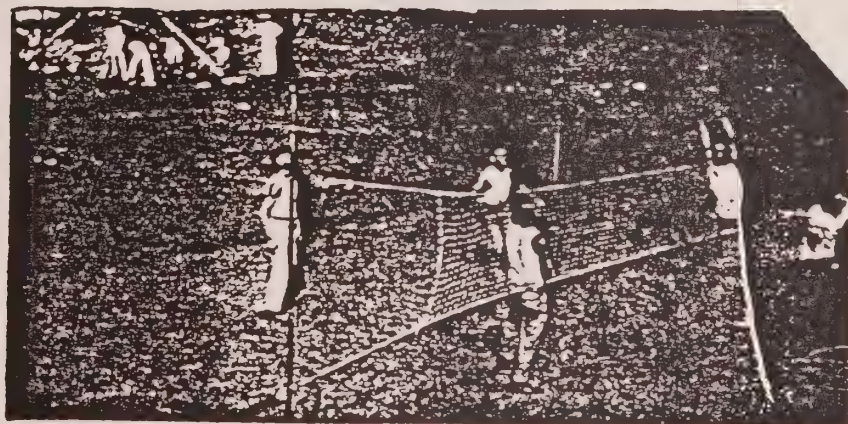
Volley ball court; DCO's quarters with
pump house on left; Wailupe 1924



Richardson with CRM Chauncey's
quarters in background - Wailupe
1924



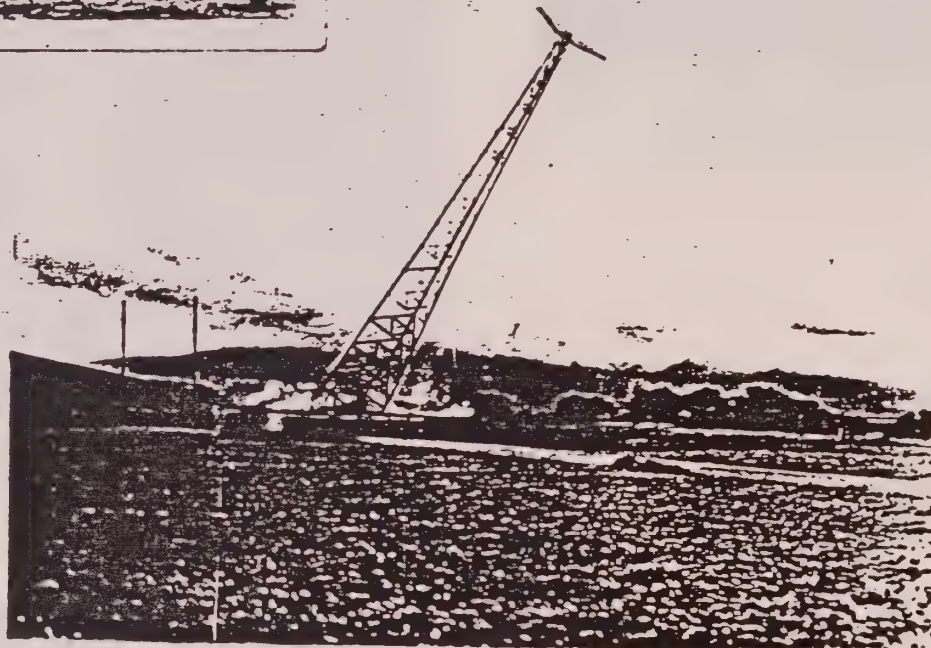
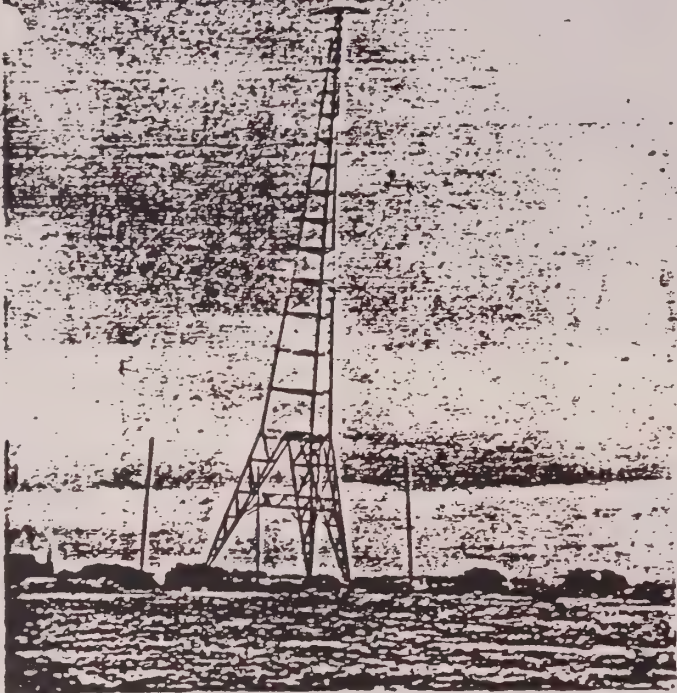
Richardson with single men's
barracks at left, Wailupe 1924



Volley ball court; DCO Frank Loftin LCDR USN
inspecting working party; Wailupe 1924

Down go the 600 foot towers at
the U. S. Navy High Power Radio Station
Pearl Harbor, Territory of Hawaii.

(About the latter part of 1937. Does
anyone know the exact date?)





U. S. Naval Radio Station, Heeia, Oahu, T.H.
View from the Pali - 1931?



Quarters for Radioman in Charge and other CRM's
U. S. Naval Radio Station, Heeia, Oahu, T.H.
Early 1930's - 100 kw arc and several
self-excited 1 kw transmitters.

U. S. Naval Radio Station (T)
Heeia, Oahu, T.H. (NHP)

Tallest wooden tower in the world!

608'

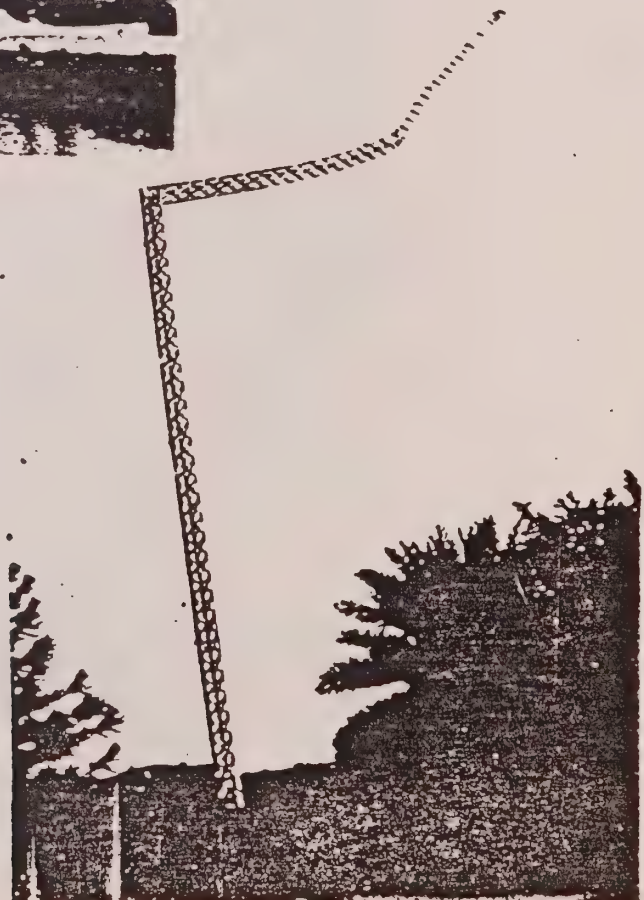


Down she goes!

1933?



On the way!





ATING BUILDING, WAILUPE

"Before"

The Wailupe Warbler SES



SOME HIGH PRICED HELP
TURNING TO

Left to right: Shryack, MacDole, Baldy, Cameron, Mr. Bradley and an unidentified worker.

"After"

These photos pinpoint the year in which the "bridge over the water" to the operating building at Wailupe was dismantled and replaced with a concrete sidewalk.

H. O. (Tommy) Thompson, then a radioman at Wailupe, wrote a column, "The Wailupe Warbler Ses," for the Army and Navy Review from June 1933 until February 1934. Here is a quote from a portion of one of his columns:

"The board walk from the road to the radio operating building was getting old, so we tore it down, filled in with rocks, (big ones they were) and laid a cement sidewalk. The fill-in was about eight feet wide and two or three feet high. We hope it will withstand the assaults of high tides in the future. Just about all hands have done their share. The regular watch standers came in for a three hour working party in the morning of their 4 to midnight watches. Mr. Bradley and Kiepler, the "straw bosses," even had such high priced help turning-to on the job as Shryack, radioman first, MacDole, machinist's mate first, and Kahn, electrician's mate first. We didn't believe it, but Cameron, radioman first, was out there too. The picture by Johnson proves it."

From Tommy's column in August 1933 we learn the date when Heeia first went off the air:

"On June 24th the personel at Heeia threw a luan to commemorate the commissioning of that station. Ye Warbler was unlucky enough to have had the 4 to 12 watch and was unable to attend."

THE NAVY'S SUPER ANTENNAE
By Staff, P.I.O.,
Department of Defense

At time you feel put out because you have to reach out the window to connection on your radio antenna lead in, give a thought to the s which confront the Navy men who operate the Naval Radio Station u, Hawaii. Theirs is the job of maintaining an antenna array which es 7,500 feet across a valley at a height on either end of 2,000 feet he ground. No masts are needed to support the five radiators in the The Navy suspended the wires by simply anchoring them at either end tops of two mountains which form a mile-wide box canyon.

om the valley floor, the five antennae overhead are almost invisible, huge twenty foot anchor insulators appear as tiny dots against the Nothing can be seen of the actual anchor sites on the tops of the ns.

Construction of the unique antenna system was begun early in 1942 ne Navy faced the need for a high-powered low frequency transmitter nunicate with Navy raiders on their distant forays into the Japanese aters. The breadth of the valley suited the requirements for a reso- ntenna to radiate low frequency signals with maximum efficiency. By mmer of 1943 Radio Haiku was in operation, and the whine of its 0-watt alternator replaced the eerie voices of ghostly warriors of st Mo, according to Hawaiian lore, had made the haunted valley of their headquarters.

n addition to the 200,000-watt alternator transmitter, the station has 00-watt vacuum tube transmitter. The transmitters feed the six miles ennae through 1,250-foot vertical leads to the center of each of the pans of antenna.

This installation is one of the Navy's largest and most powerful low-ency transmitting stations.

In addition to its constant communications with the raiders, the sta- served to augment the regular Navy communications to far-flung Pacific and island bases.

Each of the stainless steel, copper-sheathed antennae is about 1-inch ameter. They are connected to the 7/8-inch anchoring cable by a series sulators totalling almost twenty feet. The outer ends of the over-all ators are protected by corona shields which are about 3½ feet in diam-

The vertical leads are built in the form of eight-wire cages, the wires riveted to 6-inch spacer rings. One-ton counterweights, attached to bottom of the vertical leads with 300 feet of cable, compensate for the ; of both the antenna and the vertical leads.

The largest transmitter is multiple-tuned, having four 125-ampere coils; for each of the four main antennae. When using only one antenna, the smitter can load that antenna with 450 amperes at 130,000 volts.

THE NAVY'S SUPER ANTENNAE
By Staff, P.I.O.,
Department of Defense

Next time you feel put out because you have to reach out the window to clean a connection on your radio antenna lead in, give a thought to the problems which confront the Navy men who operate the Naval Radio Station at Haiku, Hawaii. Theirs is the job of maintaining an antenna array which stretches 7,500 feet across a valley at a height on either end of 2,000 feet above the ground. No masts are needed to support the five radiators in the array. The Navy suspended the wires by simply anchoring them at either end on the tops of two mountains which form a mile-wide box canyon.

From the valley floor, the five antennae overhead are almost invisible, and the huge twenty foot anchor insulators appear as tiny dots against the clouds. Nothing can be seen of the actual anchor sites on the tops of the mountains.

Construction of the unique antenna system was begun early in 1942 when the Navy faced the need for a high-powered low frequency transmitter to communicate with Navy raiders on their distant forays into the Japanese home waters. The breadth of the valley suited the requirements for a resonant antenna to radiate low frequency signals with maximum efficiency. By the summer of 1943 Radio Haiku was in operation, and the whine of its 200,000-watt alternator replaced the eerie voices of ghostly warriors of the past who, according to Hawaiian lore, had made the haunted valley of Haiku their headquarters.

In addition to the 200,000-watt alternator transmitter, the station has a 50,000-watt vacuum tube transmitter. The transmitters feed the six miles of antennae through 1,250-foot vertical leads to the center of each of the five spans of antenna.

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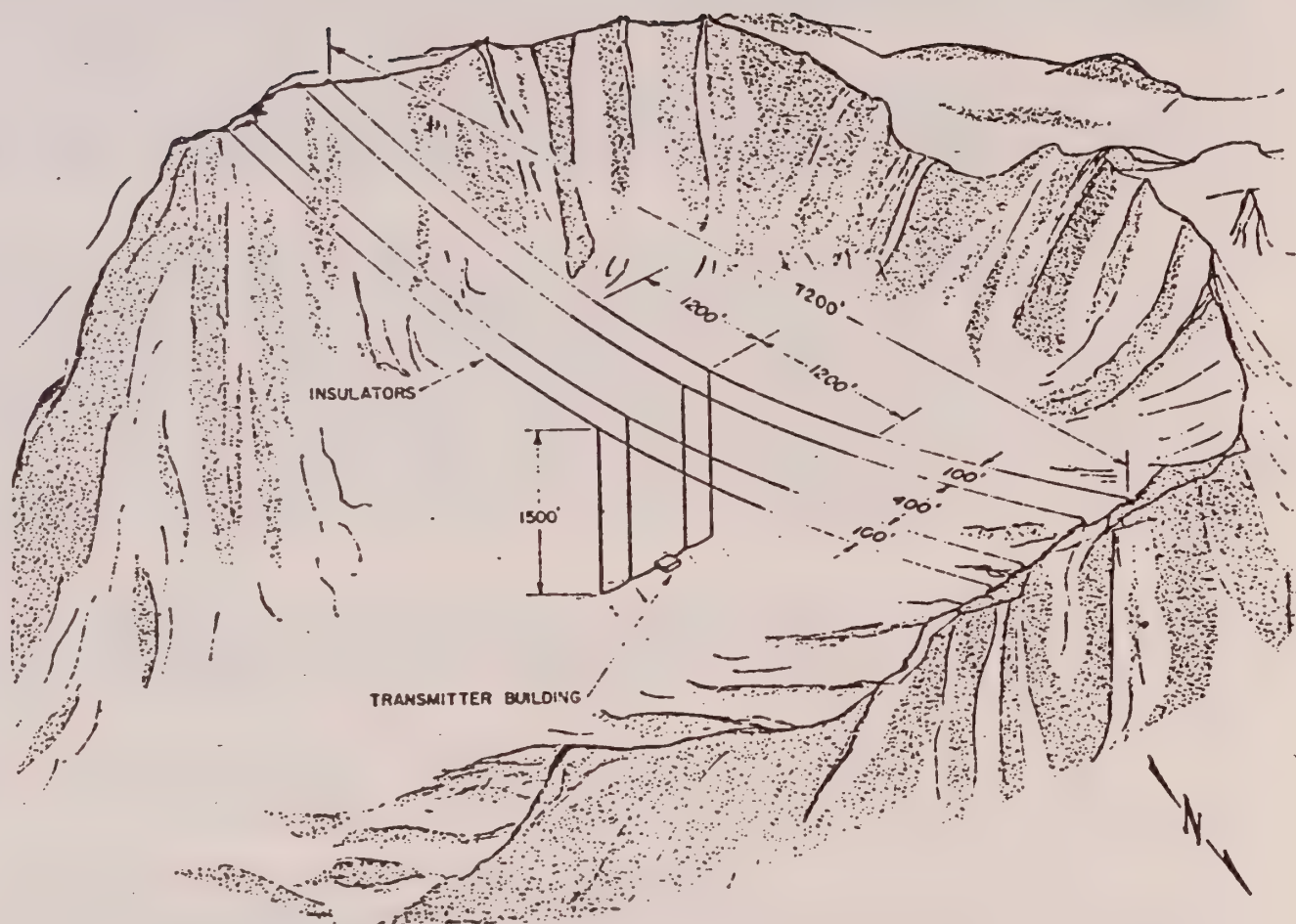


FIG. 2.8.20. Pictorial view of Haiku antenna.

Thousands of lives, millions of dollars' worth of equipment hinged on the audacity of—

THE HIGH-SCALERS OF HAIKU

Condensed from *Empire Magazine* David O. Woodbury

WHEN I visited the U. S. Navy's radio installation on Haiku volcano in Hawaii, I was alarmed—and mystified. The Navy people hauled me in a sort of bosun's chair 2000 feet straight up the sheer side of the mountain to the place where one end of a giant radio antenna was anchored. How, I wondered dizzily, could men ever have got up here to do the necessary work? When the Navy brought me down to earth again, I found out.

The story started after the victorious Battle of Midway in the summer of 1942. The whole Pacific was opening up, vast, perhaps conquerable. The Navy commander in chief at Pearl Harbor had to maintain radio contact with every naval command, even to be able to "speak" an American submarine on the bottom of Tokyo Bay, 4500 miles away.

Radio engineers said the only way to achieve such extremes of communication was via a high-flung antenna network at least 2000 feet above the ground. It was not practical to try to build steel towers to this height. The only solution was to string the wires between the peaks of two Hawaiian mountains.

The site chosen was a dozen miles from Honolulu in the Valley of Haiku, a broad amphitheater



Empire Magazine (September 1, '50), copyright 1950 by The Denver Post, Denver, Colo.

theater held in the almost vertical horseshoe crescent of an ancient volcano, one side of which had eroded away. Masses of concrete were to be set on the two wings of the horseshoe and cables strung nearly 8000 feet across the abyss between.

No man had ever been known to visit the top of Haiku. Perhaps no man could do it.

Boss-rigger Ray Cotherman assembled a gang of "high-scalers" in the jungle at the base of the south cliff, and called for volunteers. High-scalers are a rugged lot. Their job is to climb cliffs so that cables can be secured and materials hauled up for following construction crews. This job looked tough, but two men lunged forward immediately: Bill Adams and Louis Otto, both veterans of the Hoover Dam job on the Colorado River.

"There isn't a foothold in those 2000 feet of sleazy rock," said Cotherman. "But you've got to make it, boys. Three months is our deadline to put this radio station on the air!"

Adams and Otto fought their way through the underbrush to the mountain's foot. Then they began to claw and scratch their way upward, a foot at a time, side by side, so one would not deluge the other with falling rock. A hundred feet up Otto suddenly lost his foothold. He shot downward, tumbling and bouncing. Adams froze to a precarious fingerhold, scarcely breathing.

Half an hour later Otto, fortunately only bruised by his fall, was

clawing his way back up again, this time with steel spikes lashed to his belt, together with a sledge and rope. He climbed to a point just below Bill and drove a spike deep into the rock. "Stand on that!" he shouted.

Adams slid back and rested his foot on the spike. His strength was nearly gone.

As Otto said soberly, the fun was over and the real climb ahead. Now they hacked out a narrow shelf in the cliff—a kind of base of operations for the main push upward. Then Adams stuffed a few spikes in his pocket, grabbed the sledge and set out. Reaching high up, he drove home a spike. Otto, close behind him with the rope, tossed a noose over the protruding steel end, then tested it with his weight. Though the rock was nothing but a compacted mass of volcanic cinders, it held. With this help Adams wiggled himself up to a foothold on the spike. The effort had taken 20 minutes.

All that day the two men alternated at the frightening task: one driving spikes and hauling himself painfully up, while the other followed a couple of spikes below, tended the rope and, as they admitted afterward, prayed. Twice they took turns sliding back down the ever-extending rope to the valley floor for a new load of spikes and more rope. By midafternoon they had risen nearly 200 feet virtually straight up. They slid back to earth again, exhausted but still cocky.

"I'll call for more volunteers in

the morning." Cotherman told them.

"Now!" growled Adams. "Leave us alone. One of these days we'll get there!"

For five straight days Adams and Otto inched their way aloft, setting spike after spike, and securing the rope firmly around each one. Helpers were now scrambling up to the shelf with more spikes and rope, which saved much time. Then, at an elevation of 800 feet, a spike gave way as Adams stood on it. He dropped suddenly on Otto's shoulders. The shock dislodged Otto's spike and the two of them began to hurtle down. Only instinct saved them. Grasping desperately for the rope, they brought up with a fearful jerk against the face of the cliff—dazed, bruised, but still in the land of the living.

On the ninth day, now 1,400 feet above the valley, the men disappeared into dense cloud so thick that they were completely hidden from each other. They had no way of gauging how much farther they had to go, nor what the texture or shape of the rock might be directly overhead.

About noon of the 13th day Otto, working above Adams in the mist, yelled suddenly, "Hey! There's a bush up here!"

Adams shouted back, but his companion did not answer. Over and over Adams cried out. Still no reply. Alarmed, he hauled himself rapidly up. As he did so, his face plunged painfully into the bush. He

reached beyond, to pull himself past it. There was no beyond. The mountain wall had come to an end. They had gained the top.

But where was Otto? In the dense fog Adams crawled in a circle feeling in the matting of bushes. Maybe Otto had knocked himself out and was lying there unconscious. Adams stood up and yelled: "Louis! Where are you?"

The icy, wet wind snatched the cry away. He yelled again and again. No answer. Snatching up the rope, he thrashed forward. Louis must be at its end, somewhere.

What saved his life, and Otto's also, was the fact that the bushes were so rank and heavy on the mountaintop that he could not run, but had to crawl. As he moved thus, tracing the rope, he heard a faint cry, "Bill! Bill!" It was directly ahead—but far off. What had the idiot done?

Then, suddenly, he knew. As he crawled through the bushes on hands and knees, his arms abruptly ceased to support him. He found himself lying prone, his head and shoulders projecting over another cliff, which fell straight down and was lost in the swirling fog. The mountain at this spot was less than ten feet wide! Otto had gotten to his feet as he gained the crest, lurched a few steps and plunged over the far side.

Where was he now? Just then the cloud mass suddenly fell away. Brilliant sunlight washed down over the razorback pinnacle.

exposing the cliffs on both sides for hundreds of feet down. Adams saw his companion lying, perhaps 70 feet below, tangled in the bushes on a tiny shelf of rock.

Otto saw him and waved. "Greetings!" he sang out. "I'll be right up for lunch!"

To a high-scaler, the rest was routine: lowering a rope for Otto to fasten about his middle, and then hauling mightily to help him claw his way back up the cliff.

Now the whole cloud structure that had hugged the Haiku range cleared. Below them lay the green valley, stretching northward to the brilliant turquoise of the sea. The barrier reef far out scribed a curved steel nerves of two high-scalers.

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This friend of mine says over the phone, "How about taking a ride with me over to Haiku Valley? I want to get some pictures from the top of the ridge. Want to come?"

It was a slow day. "Don't mind if I do. Where's Haiku Valley?"



KRAUSS

That's the way it always starts. Innocently. The next think you know you're hanging by a thread 800 feet above the ground. If you don't believe me, listen!

Haiku Valley, I discovered on the way, is on the Windward side behind Kaneohe. During World War II, the Navy built a top secret radio station there.

This station was so powerful its signals were heard in Long Island, New York and Bombay, India at the same time.

It has five, mile-long antennas, each weighing eight tons, strung between mountain tops, both higher than the Pali.

Getting the cables up there required the combined efforts of mountain climbers and high wire men who often worked in the clouds out of sight from below.

Today the station is de-activated with only a Navy chief boatswain and a civilian rigger in charge.

But the antennas are still there. So are the cable cars that carried workmen from the valley floor to the dizzy heights where the antennas are anchored to eight-inch steel I-beams set in 10 feet of concrete poured into solid rock on the ridge line.

The cars are little cages closed over with steel mesh on three sides. They're the size of big packing crates.

I took a look at the open air car hanging from the puny cable. Then my eye followed the spectacular sweep of the steel thread as it soared up to the platform on top.

"You don't have any screwball notion of going up in this thing, do you?" I asked.

My friend nodded happily. "Sure, that's what we came for."

"How long is the cable?"

Robert Roberts, the rigger, answered, "Eight thousand feet. About a mile and a third."

"Has it ever broken?"

"Only once," said Roberts. "One strand snapped and got fouled in the block on the cable car. We had to slack tension on the cable, and let the car down on the face of the cliff so the passengers could work their way down. This cable is much better."

"How high up are you at the top?"

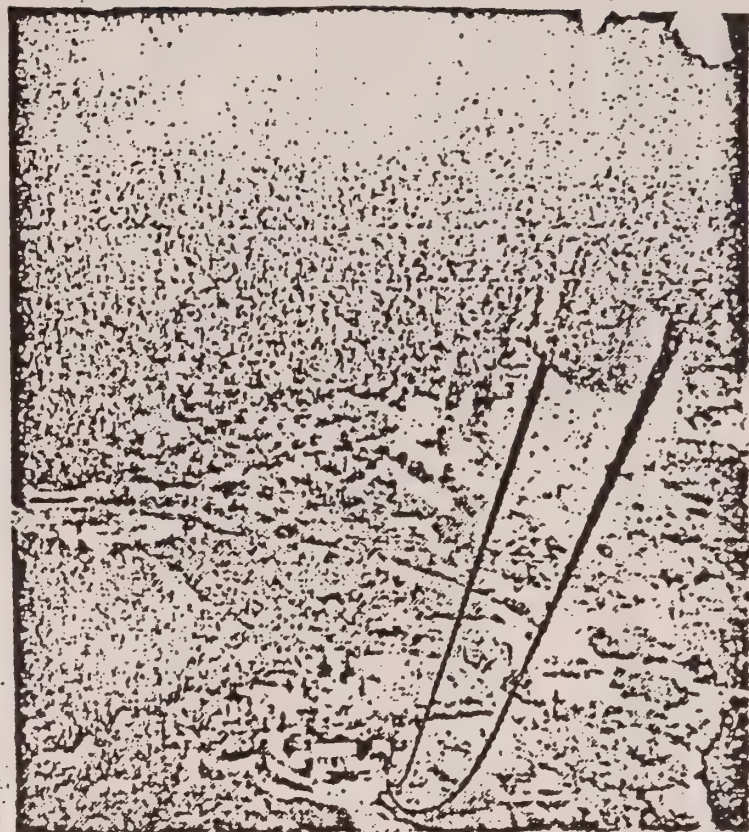
"Three thousand feet."

"How long does it take to get up there?"

"About 10 minutes."

When Chief Joe Cross said he was going up with us I felt better. But not much. Especially when I stepped into the cage. It swayed back and forth like a ball on the end of a string. There are benches on two sides.

We began to move. In a few seconds I was looking down on the cars parked below. They began



Here's how Haiku Valley looks from a cable car as it nears the station at the top of the cliff.

I noticed my friend was also sitting as still as possible to keep from rocking the cage.

"Ahem," I said, "what happens if the cable starts slipping?"

"We've had it," the chief answered casually. There was a long silence.

My friend looked up at a lever at the top of the cage. "What's this thing here?" he asked.

"Well, it was a brake but it's disconnected."

There was another long silence.

"Don't feel bad," said the chief soothingly. "I've seen Air Force pilots who get scared in this thing. Once I had to pry a guy's fingers loose from the cage before he'd get out on top."

By this time the autos were far, far below. We were moving up the face of a sheer wall of rock only a few yards away. But straight down it was a good 800 feet.

"You should go along when they grease the cable," said the chief. "They have to ride on top to do it."

"Thanks just the same," I said.

A few minutes later the car began tilting.

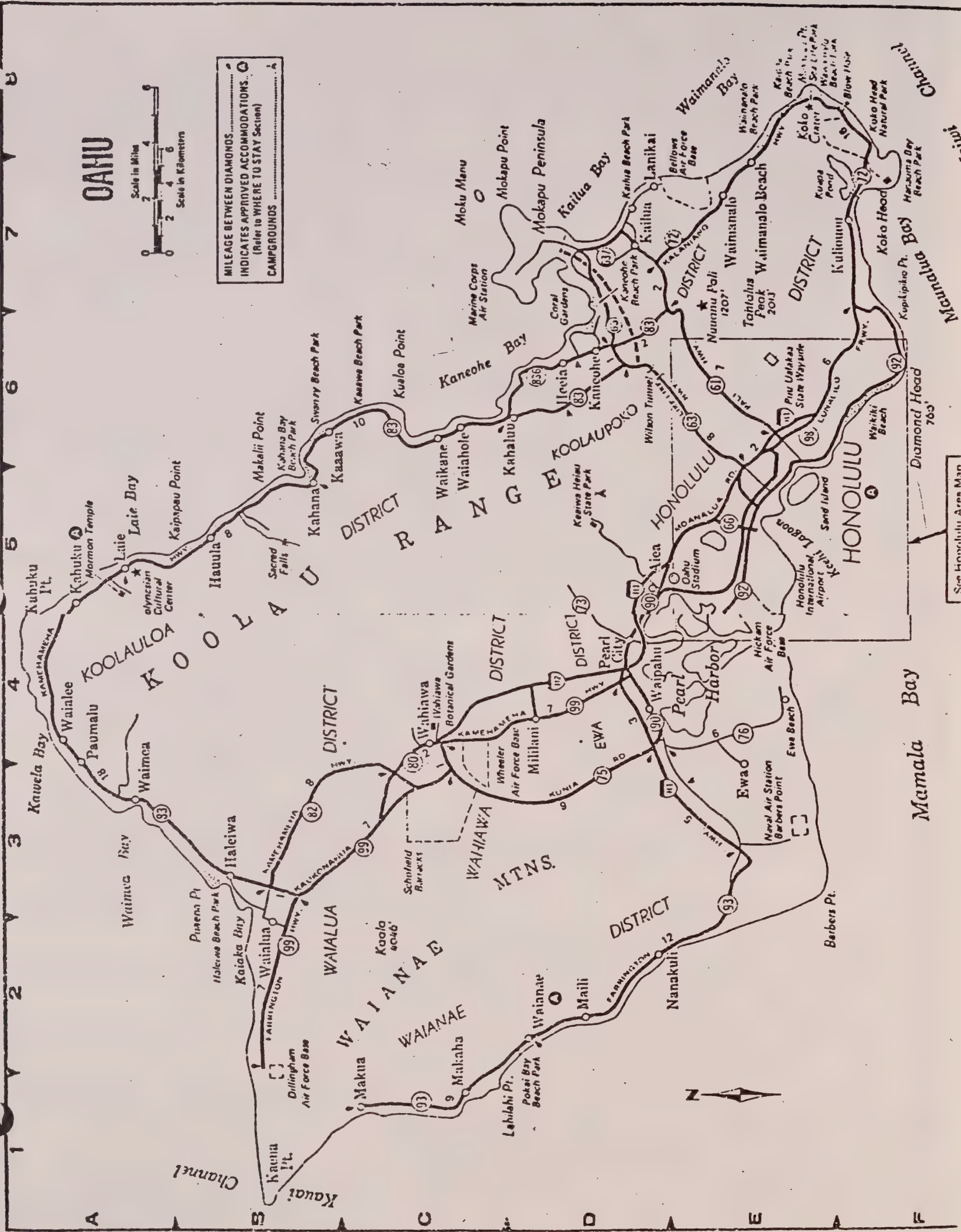
"We're almost there," said the chief.

We stopped, hanging in midair about six inches from the open door of a concrete block house. As the other two men got out, they set the cage to swinging again.

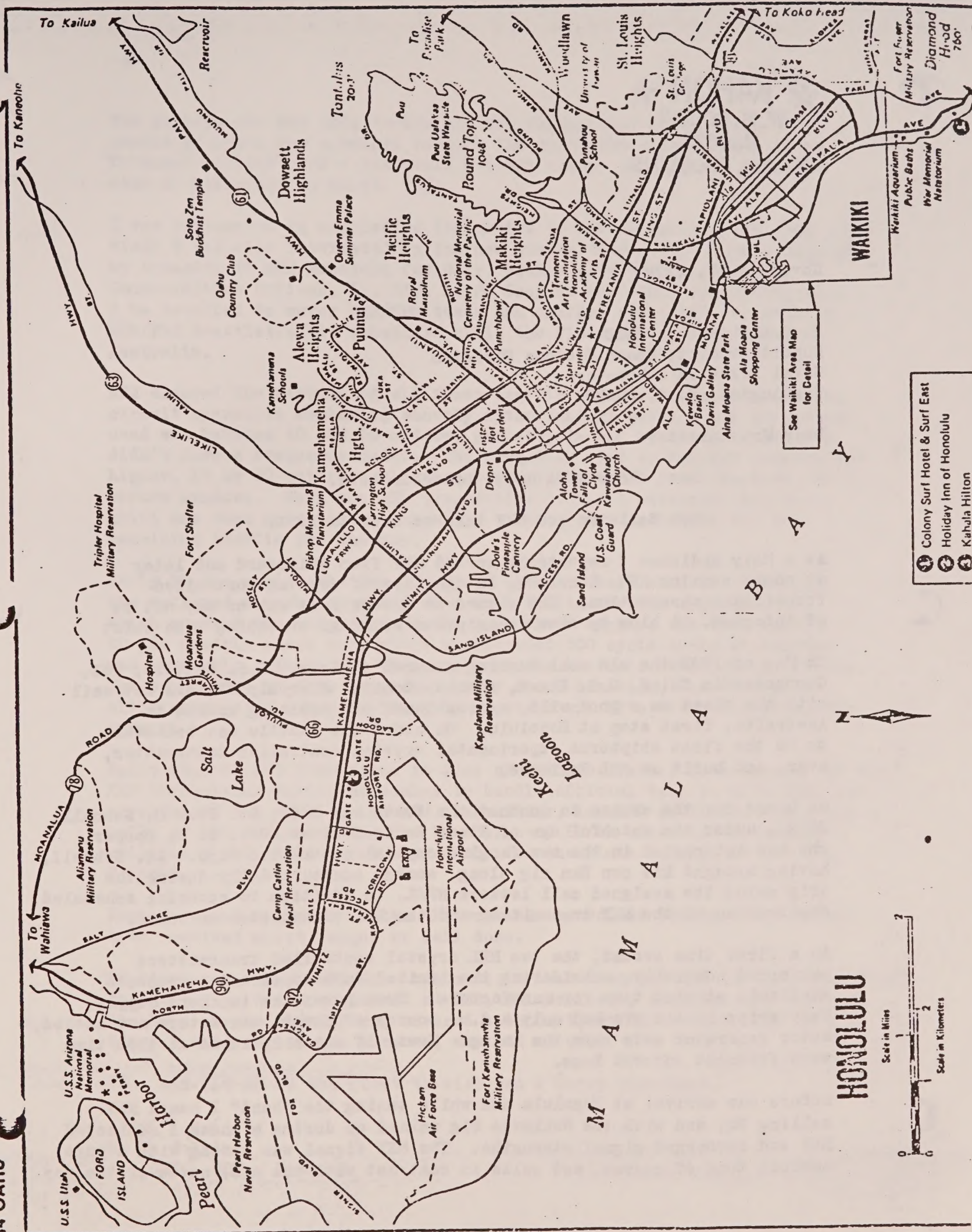
I stepped across that six inches of nothing. Then we hiked out along the ridge. The view is spectacular.

You can see the whole of Kaneohe Bay. Look the other way and you gaze down on Pearl Harbor. You can see Barber's Point and Makapuu Point by simply turning your head.

We spent a good half an hour just looking down on the vast, spreading panorama below. It was most worth the trip. I would even do it again except for the fact that it would probably be too cloudy to see anything. At least, that's the best excuse I could



MILEAGE BETWEEN DIAMONDS
INDICATES APPROVED ACCOMMODATIONS.
(Refer to WHERE TO STAY Section)
CAMP-GROUNDS



 **K4HON** 
W. H. COLVIN
Box 536
Clanton, Ala. 35045

November 27, 1972

H. O. Lorenzen, W3BLC
Superintendent, Space Systems Division
Naval Research Laboratory
Washington, D. C. 20390

Dear Mr. Lorenzen:

Re: Your QCWA note, December 1972.

NRL Bellevue and NKF take us back to 1925.

As a Navy Radioman I repeatedly worked NKF from shipboard and later at shore station NPM, Honolulu, in the days of crystal controlled transmitter observation. The record as I recall it may or may not be of interest. A blow by blow description would go something like this:

In May of 1925 the old coal burning armored cruiser U.S.S. Seattle, F8Z, Commander in Chief, U.S. Fleet, Admiral Coontz' Flagship Seattle set sail with the fleet on a good will, recreational and training cruise to Australia, first stop at Honolulu. On board the Seattle was believed to be the first shipborne experimental crystal controlled transmitter, ever, and built at NRL Bellevue.

On board for the cruise to conduct the tests was W4CF, Lt. Fred H. Schnell, USNR., under the watchful eye of Fleet Radio Officer, Cdr. S. C. Hooper, who was interested in the new-fangled crystal controlled rigs. Lt. Schnell, having brought his own Ham rig along, worked amateurs daily during the trip using the assigned call letters NRRL, in addition to covering scheduled observation of the NKF transmitter and the NRL transmitter on board.

As a first time around, the two NRL crystal controlled transmitters performed admirably, considering the limited tube types and components available at that time for manufacture. Even power was in short supply, Navy ships of the era had only a d.c. source of power, converters not needed, motor generator sets were the thing. Most, if not all, tubes at that time were filament current hogs.

Before our arrival at Honolulu and while tuning the "band" I heard NKF calling CQ, and with the Bellevue rig warmed up during a check I contacted NKF and exchanged signal strengths. The NKF signal was strong with a pure musical tone of course, and quite in contrast with the a.c. notes of the day.

The Seattle was not able to use the NRL transmitter more than a couple of hours per schedule because the final tubes demanded a heavy filament current from a lead acid battery source of supply. Only one bank of batteries on board. Hi

I was interested in completing the cruise to Australia on board, but since I was also interested in the new transmitters, Cdr. Hooper arranged my transfer to NPM Honolulu for duty, with a note to the District Communication Officer, Lt. Cdr. L. R. Gray at the time, suggesting that I be detailed to cover NKF/NPM tests and traffic schedules, as well as NPM/F8Z Seattle traffic schedules while the Fleet was enroute and in Australia.

NPM cleared the Seattle of all fleet traffic nightly during the cruise, circuit operation beginning shortly after sundown because the frequency used was between 40 and 50 meters, probably in the vicinity of 50. We didn't have a frequency meter. The frequency used by NKF/NPM however was higher, 18 or 20 meters, schedules beginning at 1700 Honolulu time, well before sundown. When the NRL transmitter filament batteries ran down shift was then made to Lt. Schnell's transmitter to finish off any remaining traffic for the day.

Early in the cruise the Ham 500 cycle note was born when Lt. Schnell's rig suffered a power casualty when a field lead became disconnected which wrecked the motor end of the m.g. plate supply. He then turned to the Seattle store room where a discarded 500 cycle spark alternator was available. There and then was born the historic NRPL 500 cycle note. The popularity of this new note was of short duration, the 500 cycle alternators soon being replaced by crystals and VFOs with filtered power supply.

Radio Central NSS Washington in June of 1925, or later, took control of the NKF transmitter during schedules to handle official traffic with NPM, for a period of two weeks. The NPM transmitter, located at Heaia, Oahu, was built by CRE McCutchan who was in charge of Heaia station. McCutchan utilized a 500 cycle spark alternator for the plate supply, as did Lt. Schnell.

Designers and builders of the NKF crystal controlled transmitters should have received merit badges or well done.

My story more in brief, Mr. Lorenzen, is that I worked NKF in the early days. Incidentally, I was a student at RMS, NRL Bellevue, in 1935; and there in the Lab sat the old NKF rig covered with dust, still workable but by this time, having served its purpose, was out of use.

73. and let me be the first to wish you a Merry Christmas.

W. H. Colvin
W. H. Colvin,
CRE., USN., Retired

